



Coastal Hazards System (CHS) Web Tool User Guide, v2.0

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1 About the Coastal Hazard System

The Coastal Hazards System (CHS) is a national-scale effort for the quantification of coastal storm hazards and distribution of Probabilistic Coastal Hazard Analysis (PCHA) results and statistics¹. The main components of the CHS include the PCHA, data repository, web-tool for easy access to results, and website containing documentation and metadata. The PCHA is an innovative framework integrating the comprehensive characterization of regional storm climatology, advanced joint probability analysis of storm forcing and storm responses, high-resolution atmospheric and hydrodynamic numerical modeling, and cutting-edge machine learning techniques and metamodels.

Data distributed through the CHS includes numerical model output for storm surge, waves, currents, and wind associated with tropical and extratropical cyclones. Hazard curves developed using the PCHA are also provided for still water level (SWL; storm surge + astronomical tide), significant wave height, and peak wave period. These hazard curves represent the magnitude of the hazards as a function of their annual exceedance frequency (AEF) along with corresponding uncertainties. The CHS provides a centralized location for PCHA results to support feasibility studies, economics analyses, evaluation of nature-based features, stochastic engineering designs, and risk and resilience assessments.

1.1 The Web-Tool

The Coastal Hazards System (CHS) Web Tool has been in use with a map interface through several revisions. In February 2015, a version was stood up as CHS v1.1 on the ERDC RDE network providing access to data from the NACCS and USACE Texas studies. The CHS web tool went through modifications in 2016 to allow easy viewing and downloading of statistics results. However, as of September 30, 2021, CHS v1.1 was taken offline and is no longer available for accessing or downloading of data.

In 2021, CHS v2.0 was stood up with modifications that include a new graphical user interface, revised data storage architecture to meet future data storage needs, and a web-based data mining and visualization tool capable of supporting national scale data. The revised data architecture is designed with scalable data storage options as future studies provide more data, to improve the relational storage of files and content and to incorporate indexed SQL queries. The Graphical User Interface/Mapping (C# & .Net, ESRI API) is a more robust ESRI API for industry standard mapping and tools. A common design and interface scheme with StormSim² and pre-defined formats for interoperability provides consistent data integrity and appearance. User access was enhanced to provide access to desired information via filter-able data and metadata in the database.

The overall framework and *Navigation Pane* are similar to CHS v1.1 with improved display of

¹ For more information see: Nadal-Caraballo, N.C.; Campbell, M.O.; Gonzalez, V.M.; Torres, M.J.; Melby, J.A., and Taflanidis, A.A., (2020). Coastal Hazards System: A Probabilistic Coastal Hazard Analysis Framework. Journal of Coastal Research, 95(sp1), 1211-1216. <https://doi.org/10.2112/SI95-235.1>

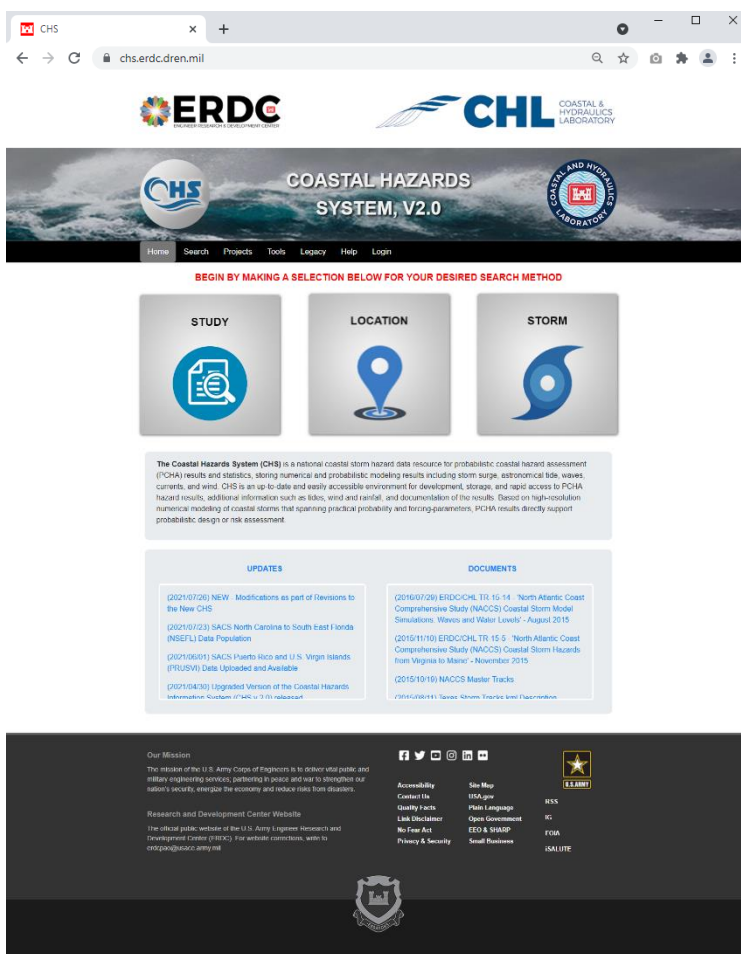
² For more information see: Torres, M. J., Nadal-Caraballo, N. C., Ramos-Santiago, E., Campbell, M. O., Gonzalez, V. M., Melby, J. A., & Taflanidis, A. A. (2020). StormSim-CHRS: Coastal Hazards Rapid Prediction System. Journal of Coastal Research, 95(sp1), 1320–1325. <https://doi.org/10.2112/SI95-254.1>

information and selection of data. Map views, data visualization, selection tool, and some navigation was updated within the 2021 release. This User Guide illustrates how to maneuver in and obtain data from the CHS v2.0 website and web tool.

1.2 Getting Started

The CHS landing page is shown below in Figure 1 and can be accessed at <https://chs.erdcdren.mil/>.

Figure 1: Coastal Hazards System (CHS v2.0) Landing Page



The CHS landing page contains a *Menu Bar* and buttons to enter the web tool by Study, Location, or Storm. These buttons allow entry into the web tool based on the user's focus as defined below. Apart from the entry buttons, the landing page includes background information and newsfeeds, which show updates regarding the database and published documents related to CHS and the PCHA framework.

The *Menu Bar* on the landing page, and on pages throughout CHS, contains links to several other pages or information:

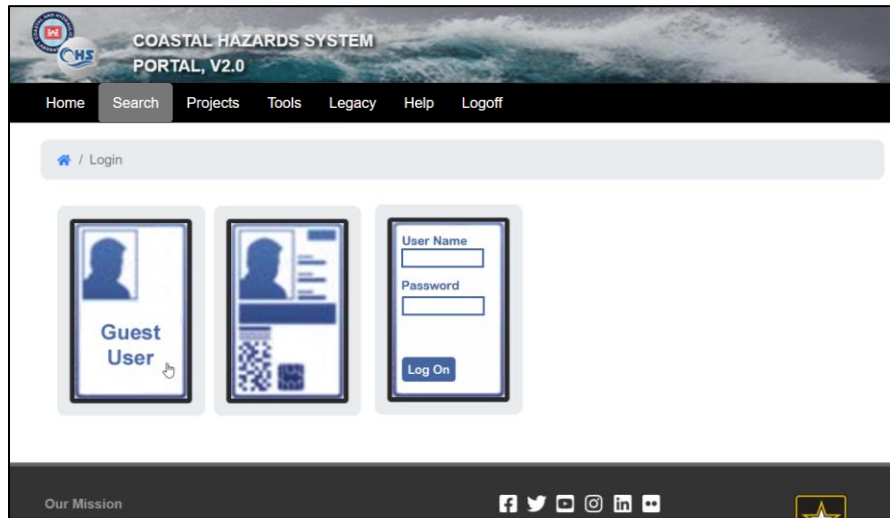
- **Home:** returns the user to the landing page, where they can enter the database using the three main methods (Study, Location, or Storm), and access documents, guides, and other USACE sites
 - **Study:** view comprehensive coastal studies, view point locations where data is stored,

visualize data and hazard curves by clicking a point, filter and download available modeling and statistics data

- **Location:** enter a location of interest to view point locations where data is stored, visualize data and hazard curves by clicking a point, filter and download available modeling and statistics data
- **Storm:** view storm tracks and parameters applied in comprehensive coastal studies, view point locations where data is stored, visualize data and hazard curves by clicking a point, filter and download available modeling and statistics data
- **Search:** change method for entering the web tool
- **Projects:** Page describing regional comprehensive studies and related projects housed in CHS
- **Tools:** opens a webpage containing tools for downloaded datasets including conversion from HDF5 to other formats
- **Legacy:** links to the Legacy CHS website hosted at <https://chs2.erdc.dren.mil>
- **Help:**
 - **About Us:** information about CHS and the Coastal Hazards Group
 - **Contacts:** contact information
 - **Documents:** available reports, briefings, and study-specific files for downloading
 - **FAQ:** frequently asked questions related to CHS
 - **Quick Start Guide:** link to guide which illustrates how to move through the web tool and access data
 - **Updates:** links newsfeed on the landing page to information related to system and study updates
 - **User's Guide:** link to the guide describing the web tool, data formats, and naming conventions
- **Login:** login and account information for CHS

After pressing an entry button, such as *Study*, a registration page will be displayed, with a selection button for guest registration, which allows access without email login. As illustrated in Figure 2, functionality is currently under development to use a CAC or Email registration to enter the system (Email registration requires a user selected email and password that will help determine usage of the web tool). After registration, the user will be brought to the CHS Web Tool. If the tool is left inactive for an hour, re-registration will be required.

Figure 2: Representation of Future CHS Portal Registration Page



1.3 Save Points

Data in the CHS Web Tool are associated with Save Points, which are located at specified locations (latitude and longitude). However, each model's results hosted by CHS may have different numerical IDs for their native save points, which are referred to in CHS as co-located IDs. CHS tools may refer to co-located IDs or save points by model (i.e. ADCIRC -2234). More information on the individual models may be viewed in the Documents and Resources sections in the *Menu Bar*.

1.4 Web Tool Navigation

Figure 3 shows the CHS v1.1 tool that this version is following, but will be available for some time at the website listed in the *Menu Bar*. The CHS v 2.0 version is shown in Figure 4. There are three main sections to the CHS Web Tool: the *Menu Bar* along the top edge of the page, the *Navigation Pane* on the left and the *Map Interface*. The *Menu Bar* is the same as discussed above in the Getting Started Landing Page section. The *Navigation Pane* provides data selection options, and the *Map* allows the user to view, select, and investigate data through popups at each Save Point.

Figure 3: CHS v1.1 Web Tool Main Page (retired)

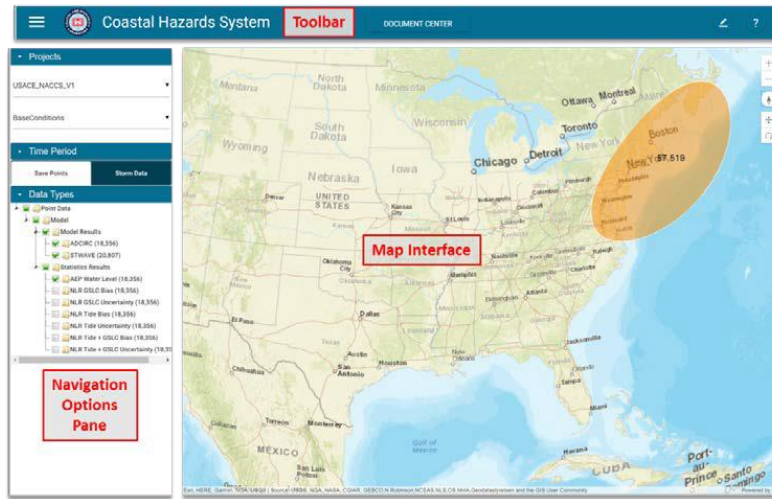
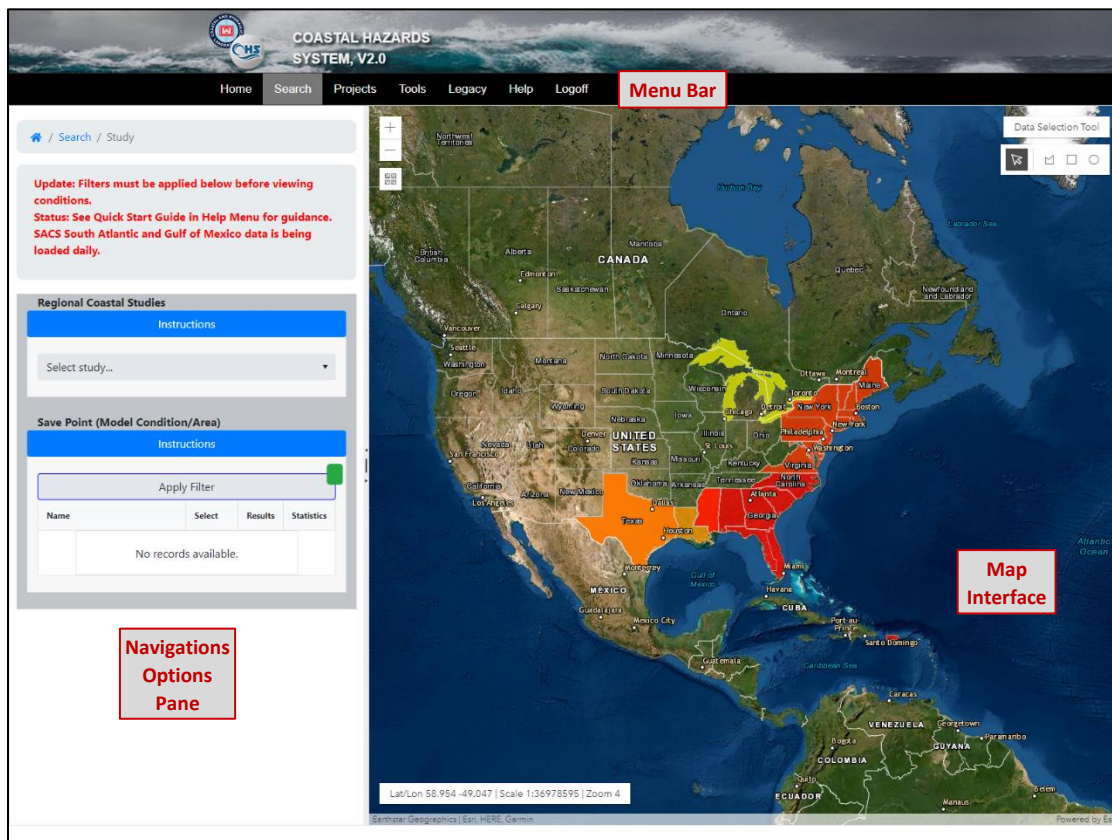


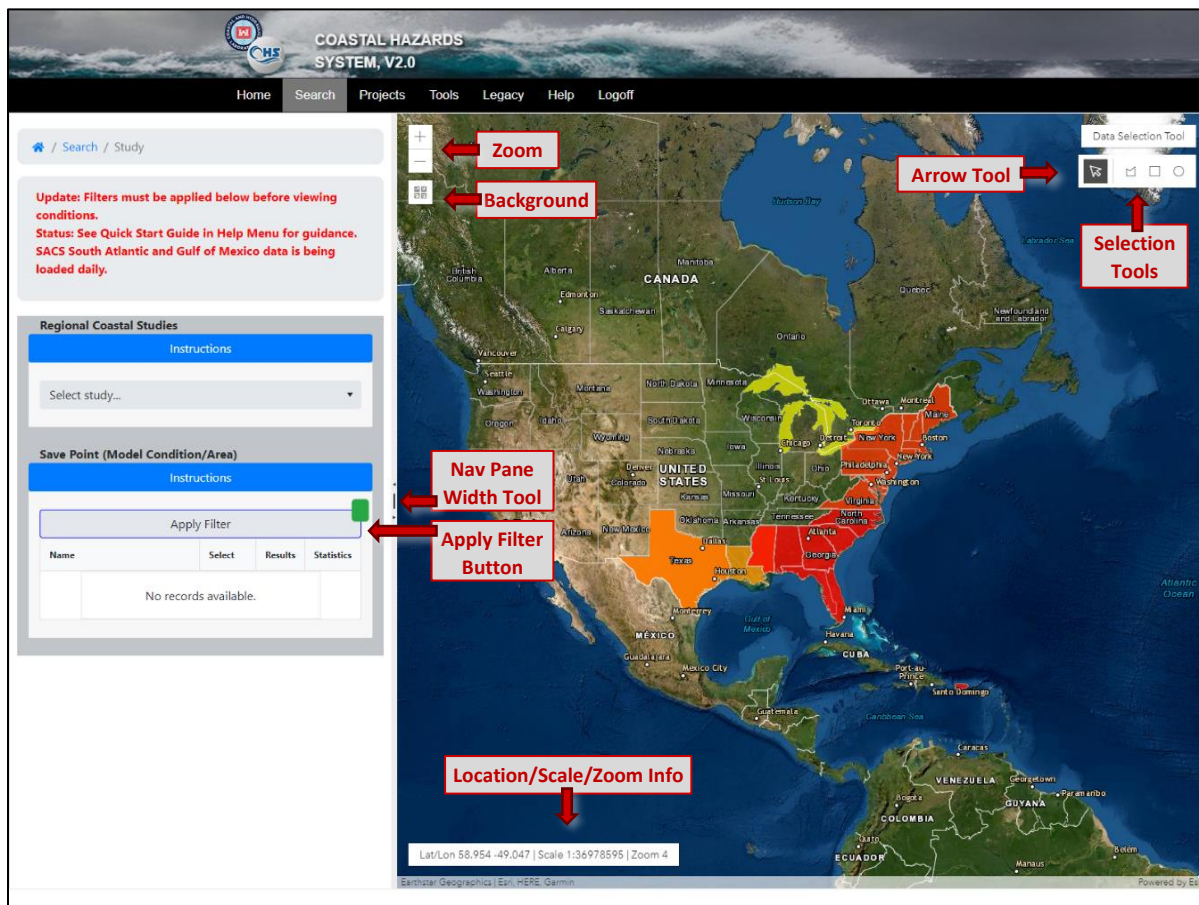
Figure 4: New CHS Web Tool Main Page with main user interface areas indicated



When the Web Tool is entered by the *Study* option, the *Map* is opened with all studies shown as polygons of the states included in each study. After selecting a study in the Regional Coastal Studies dropdown, the Save Point (Model Condition/Area) box will be populated with model run conditions assessed for the selected study. To see more of the *Map*, you can use the tools on the light gray vertical bar between the *Navigation Pane* and the *Map* (Figure 5). Grabbing the middle line (pressing and holding down the mouse button) allows you to adjust the width of the panel, similar to adjusting a table

width in Word or a cell width in Excel. The left and right arrows collapse and open the pane. More detail on filtering, viewing, and selection data at the Save Points is provided below.

Figure 5: Map Interface Tools



1.5 Basic Map Navigation

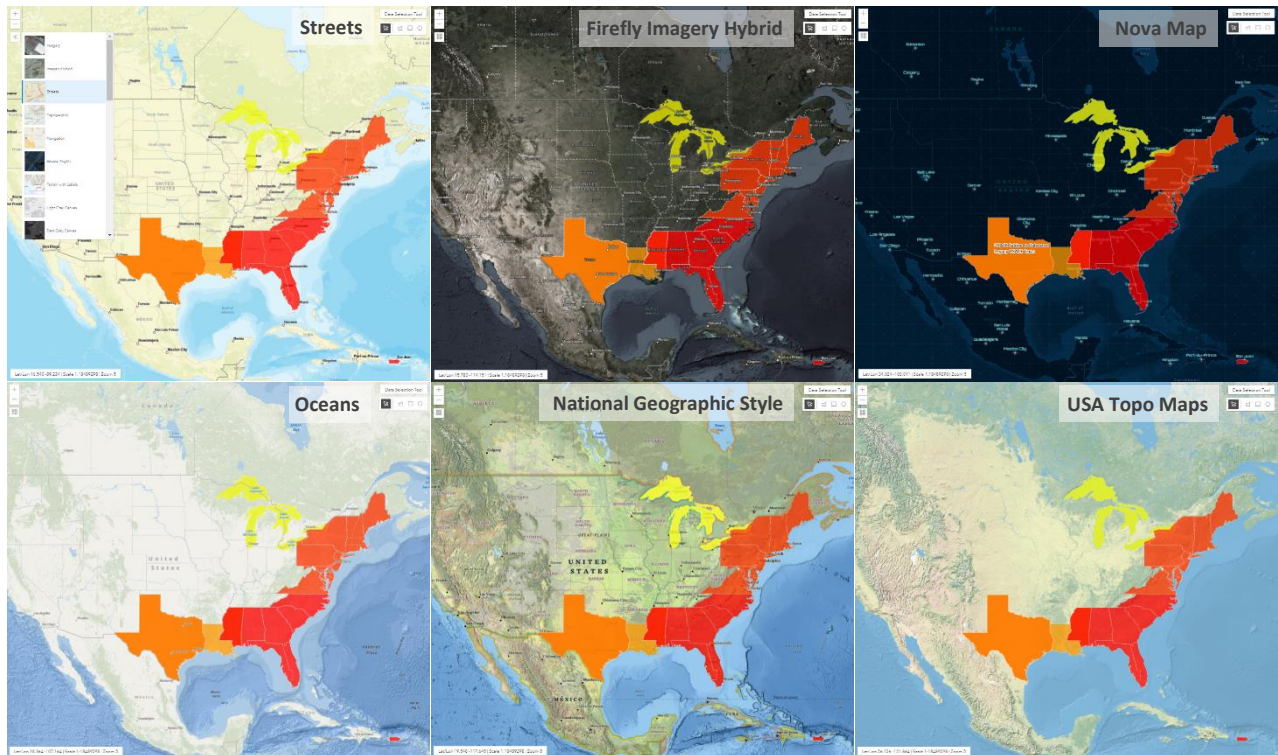
The *Map Interface* is similar to CHS v1.1. Use the mouse wheel to scroll/zoom in and out on the *Map*. To pan or move the *Map* to another location, click on the *Map*, hold down the left mouse button, and drag the mouse. You can also use the plus and minus buttons on the upper left-hand side of the *Map* to zoom in and out (Figure 5). The zoom distance is also reflected in the bottom left bar that shows latitude and longitude coordinates, scale, and the Zoom Level. Zoom Level is used to determine scaled size of hexagons and points. When zooming or panning in an area that is dense with save points, the *Map* may show a spinning blue and white circle (Figure 6) to indicate it is processing.

Figure 6: Processing Icon



On the top left, below the zoom buttons, there is a tool to select different backgrounds for the *Map* which looks like four small maps. Examples are shown in Figure 7. The default background is *Imagery Hybrid*. On the top right of the *Map* (Figure 5) is the Arrow tool that is active when panning and using tools discussed in the Save Point Navigation section. The shapes next to the arrow are for selecting data points, which will be discussed in the Spatial Save Point Selection section.

Figure 7: Example Map Backgrounds

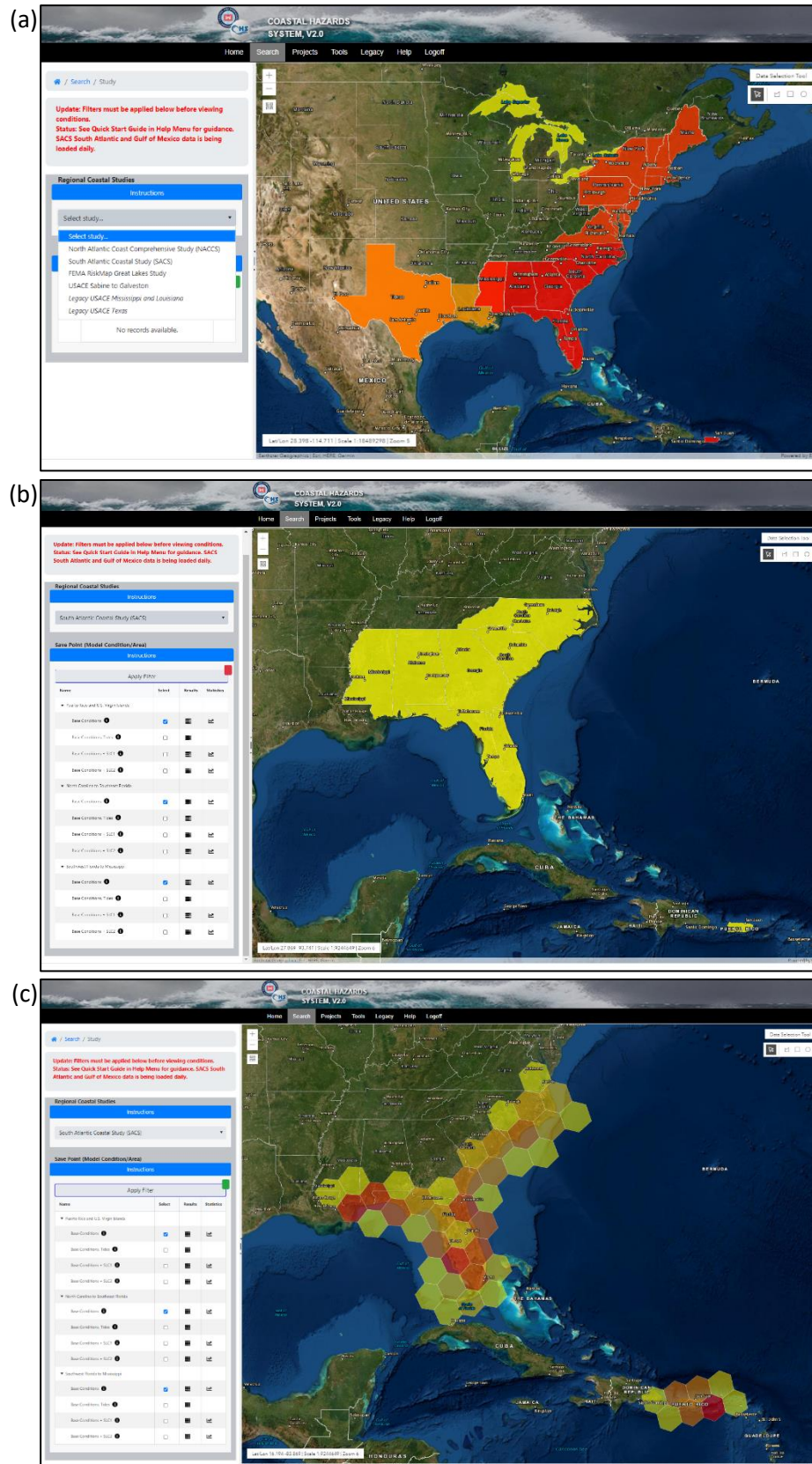


1.6 The Navigation Pane

The *Navigation Pane* is where the study of interest is selected and the model condition or sub-area for save points, or storm tracks if entering through the Storm entry button, are visualized on the *Map* and/or selected with the Data Selection tools for data downloads. The selections in this *Pane* are synced with the *Map Interface* allowing users to focus on their area and data of interest. To access point specific data, begin by selecting a *Study* from the *Regional Coastal Studies* list at the top of the *Navigation Pane*. In order to access the list, click on the down arrow and scroll down to the study of interest (Figure 8.a). After the study is selected, its name alone will show in the top *Study Box* and only the study region polygon will be shown in the *Map*.

Users must press “Apply Filter” (Figure 5) to enable changes made in the navigation pane to be shown on the *Map*. Once the filter has been applied, the red square to the top right of the “Apply Filter” button will turn green indicating that changes have been applied to the *Map* (Figure 8.b and 8.c). Hexagons will appear after applying the filtered conditions where darker (more red) hexagons indicate more save points in a given area (Figure 8.c). The hexagon color gradation will be automatically scaled to display the darkest color in the densest save point hexagon for only this specific Coastal Study Region.

Figure 8: (a) Study Selection; (b) Save Point Model Condition / Area Table; (c) Apply Filters to Map.



The *Save Point Section* of the *Navigation Pane* will populate with areas (or sub-regions) or model conditions. By default, only the modeled base conditions are selected when the regional study is chosen (Figure 8.b). The storage of model results (output data from ADCIRC, STWAVE, WAM, and/or SWAN), and Statistics Results (AEP, AEF, NLR) for the specific model conditions or sub-regions will be indicated by icons in those columns. If no icons are shown in the Results or Statistics columns, no data is unavailable for the selected study and Model Condition or Area. To turn on/off conditions or sub-regions, click the boxes under the *Select* column in the *Navigation Pane*. For example, if the Base Conditions were only turned on for Puerto Rico and the U.S Virgin Islands, then only the hexagons relative to this region would be displayed on the map.

1.7 Save Point Navigation

In CHS, colored hexagons are used to represent areas that contain save points³. Areas with denser points are shown in a darker color (e.g. red) while areas with fewer points are shown in a lighter color (e.g. yellow). Hovering over a hexagon displays the number of save points in that hexagon area (note the mouse arrow in Figure 9 pointing to San Juan and showing 2306 savepoints in that hexagon). As you zoom in, the hexagon sizes are smaller to provide more detail. Note that individual points can only be viewed at a zoom scale (Zoom Level 11 or smaller) which was decided to limit the screen lag as the user navigates to the area of interest, as there is a tremendous amount of underlying data (Figure 10). In any given region, the point density will vary, therefore to query a specific point, a Zoom Level 10 or 11 may be more useful, particularly in point dense areas. For example, in Figure 11, zooming in to about 1m : 300 km (Zoom Level 11) finally spaces out save points in the ocean, though point density near the shore is high, which provides the resolution for the SACS (Figure 11). Over 1000 save points are located in the shaded polygon shown here representing the coastline and near shore of the San Juan area.

³ In the former CHS v1.1 map interface, as shown in Figure 3 above, a single shaded ellipse covered the region of a selected study. The number inside the polygon represented the number of underlying save point locations.

Figure 9: Puerto Rico and U.S. Virgin Islands SACS Sub-Region at Zoom 6 (Scale ~ 1m : 10,000 km)

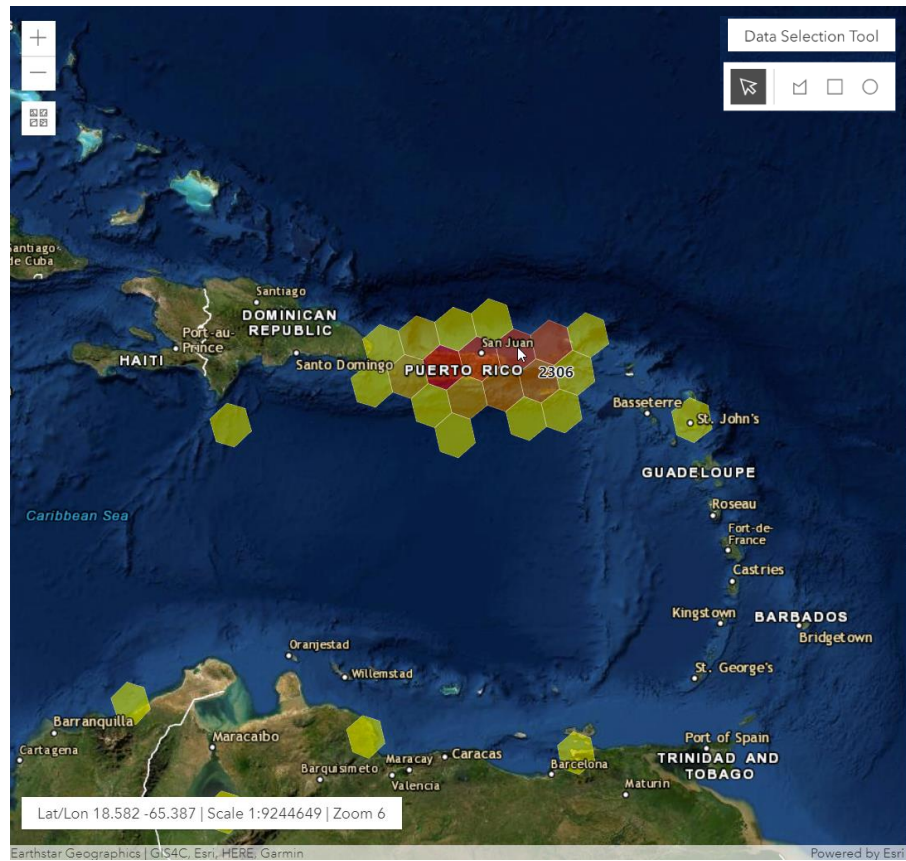


Figure 10: Puerto Rico and U.S. Virgin Islands SACS Sub-Region: Left at Zoom 7 (Scale ~ 1m : 5,000 km); Right at Zoom Level 9 (Scale ~ 1m : 1,000 km)

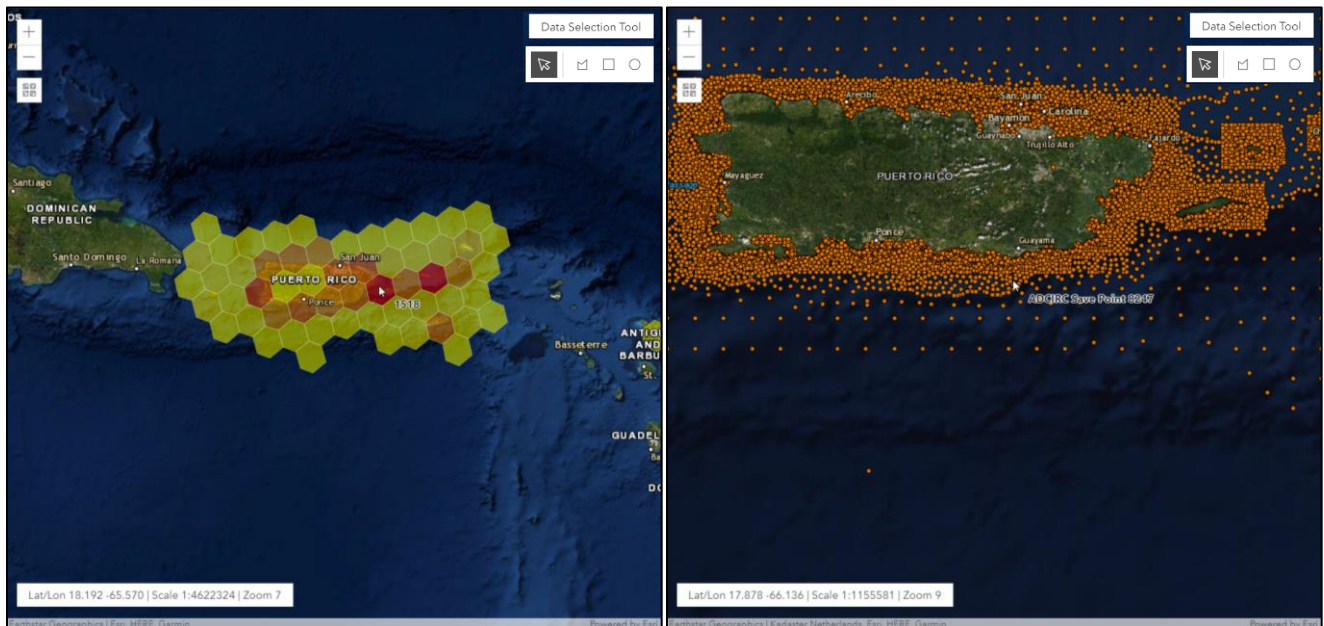
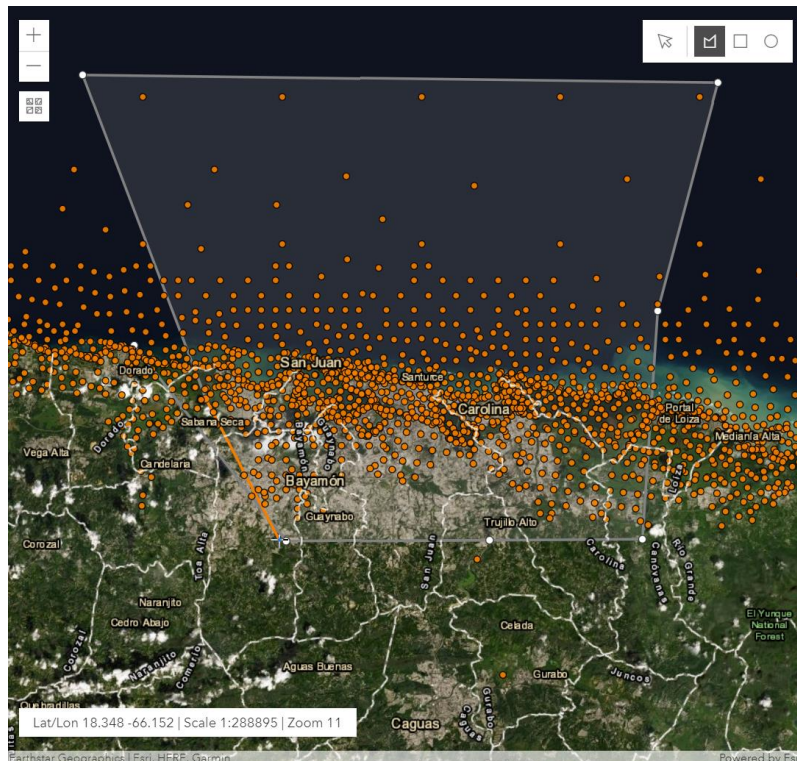


Figure 11: Puerto Rico and U.S. Virgin Islands SACS Sub-Region at Zoom 11 (Scale ~ 1m : 300 km)



Once navigated to the level of interest, here near Long Island in the NACCS Study Region, and close enough that individual points can be selected, *hovering* over a point will display a text label that identifies the save point by its ADCIRC save point ID (Figure 12).

A *pop-up information window* will appear if you click on a save point with the cursor and a cyan circle will surround the selected point. This window displays the location coordinates on the top, the co-located savepoint IDs and a set of tabs (Figure 13 and Figure 14). Each tab lists the parameters that are stored for the point in CHS for that tab's model results (e.g. ADCIRC, STWAVE, WAM, AEP, etc.) or statistical results (AEF/AEP, NLR). The information displayed in the save point pop-up will reflect only the model conditions selected in the *Navigation Pane* (Figure 15). The AEP statistics tab also provides links to the hazard curves as a downloadable image by clicking on the graph icon in the tab.

A scroll bar is provided in the pop-up to access information. To see the information more clearly, the user can dock the pop-up information on the right side of the screen where it will be taller. To dock the pop-up, click on the dock (a wide box and narrow box together) on the top right next to the 'X' icon. To return to the pop-up, click on the pop-up icon (two overlapping boxes, Figure 16).

You may also use this tool to zoom in on the point you are querying. By pressing the *Zoom to* button, the *Map* will zoom two zoom levels closer to the point being queried. This zoom in function can be repeated as in Figure 17.

Figure 12: Hover Text for a save point

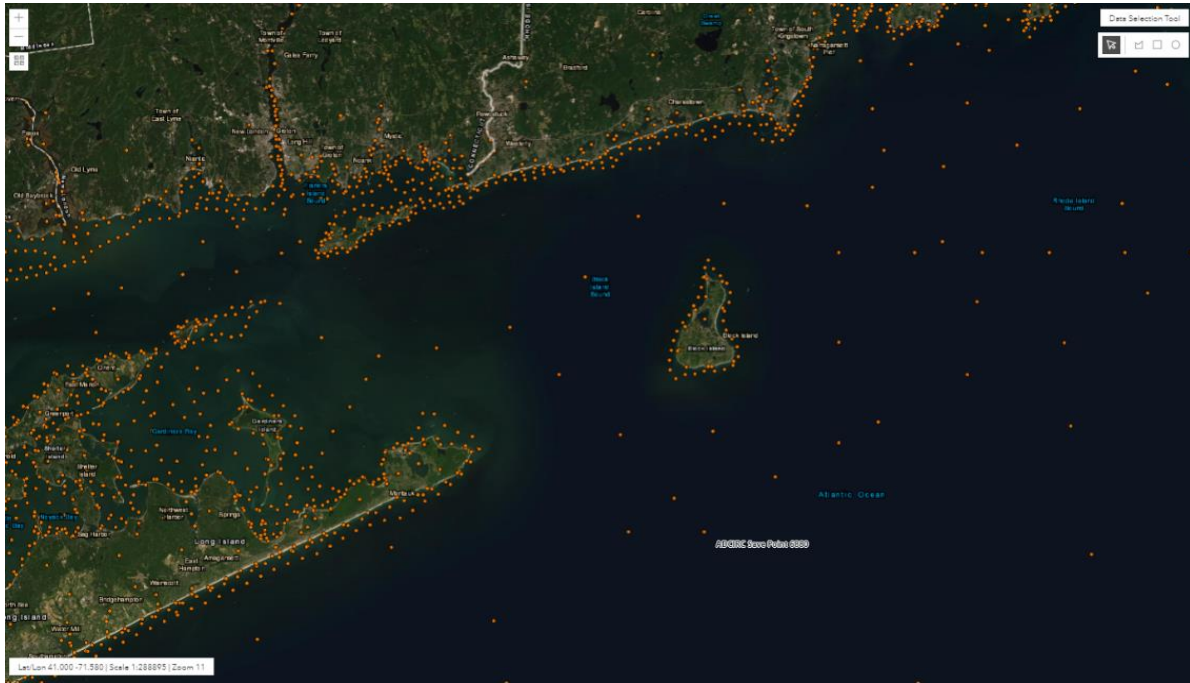
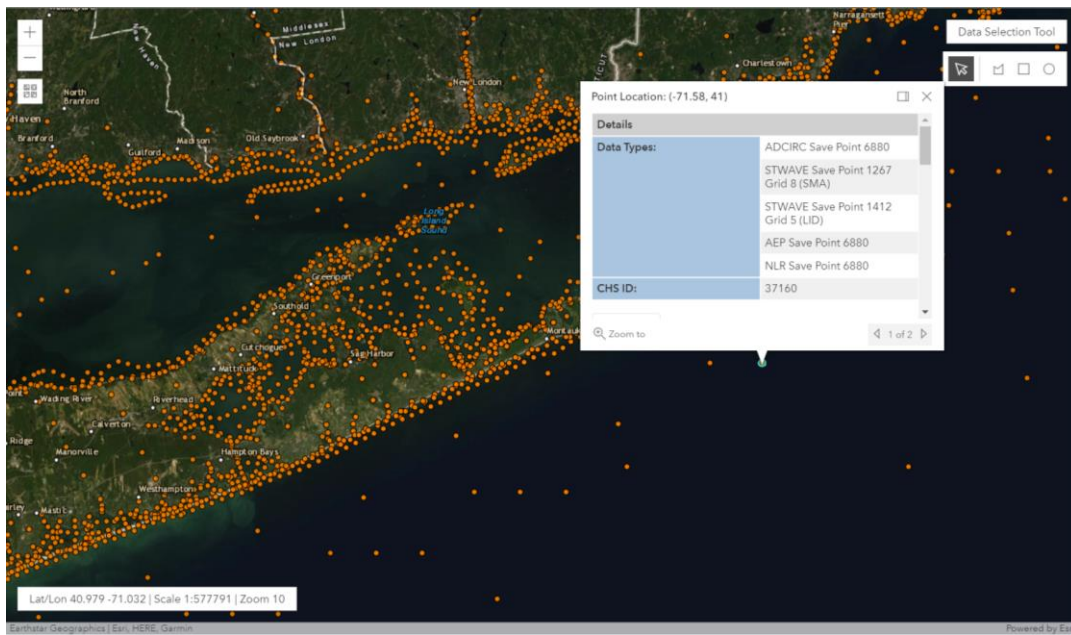


Figure 13: On Click Pop-up Window General Information



The screenshot displays the Earth Engine web interface. The main map shows a coastal region with numerous orange data points. A 'Data Selection Tool' panel is open on the right, showing the 'Point Location: (-71.58, 41)'. Below this, there are tabs for 'ADCIRC', 'STWAVE', 'AEP', and 'NLR'. The 'Base Conditions + SLC1' section is expanded, showing a table of parameters:

Parameters:	
Atmospheric Pressure (hPa)	
Water Elevation (m)	
X/Y Depth Averaged Velocity (m/s)	
X/Y Wind Velocity (m/s)	

Below the table, there is a 'Base Conditions' section with a zoom slider and a 'Zoom to' button. The bottom status bar indicates the current location and scale: 'Lat/Lon 41.119 -71.040 | Scale 1:577791 | Zoom 10'.

The Storm Tracks *Map* display capability is currently under development and will be available soon.

Spatial query tools are currently under development and will be available soon.

Figure 10 shows two screenshots of the NLR Save Point dialog box. The left screenshot displays the 'Base Conditions' tab, which includes parameters for atmospheric pressure, water elevation, and X/Y depth averaged velocity and wind velocity. The right screenshot displays the 'NLR' tab, which shows the 'NLR Save Point 6880' section with a table of base conditions for gslc, tide, and tidesgslc.

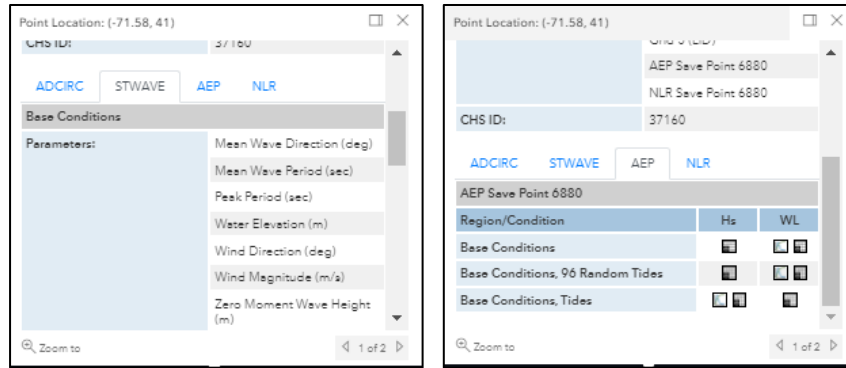


Figure 16: Using the Double Square Box Tool to show Pop-up Window on Map edge and taller

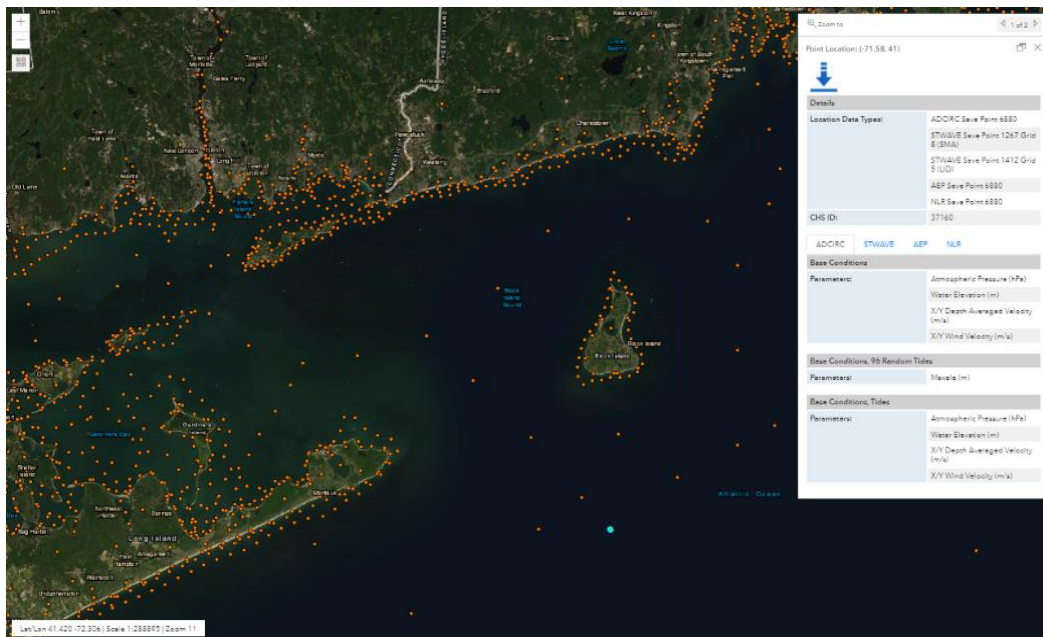
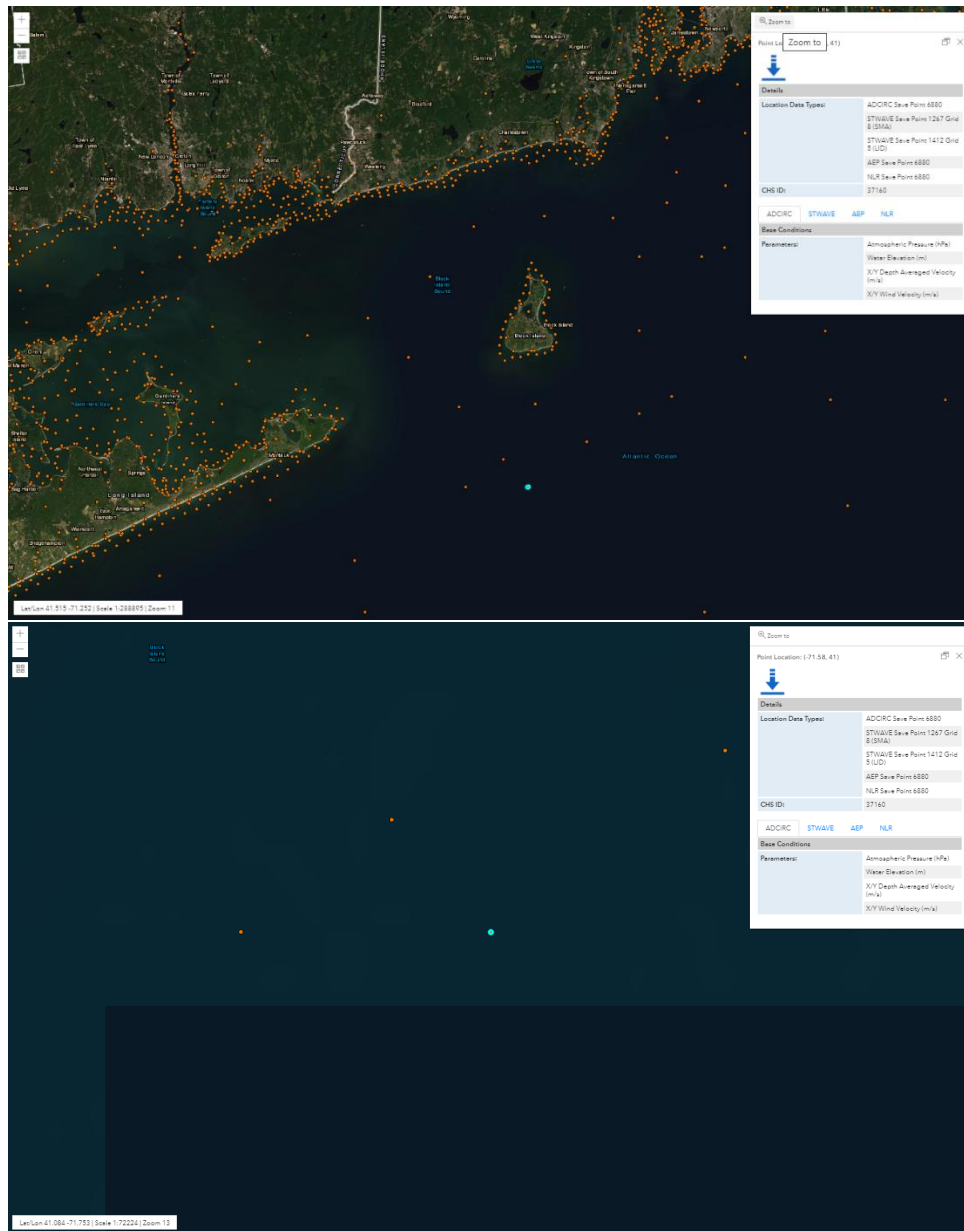


Figure 17: Selecting the Zoom to tool for the point circled in cyan



1.10 Spatial Save Point Selection

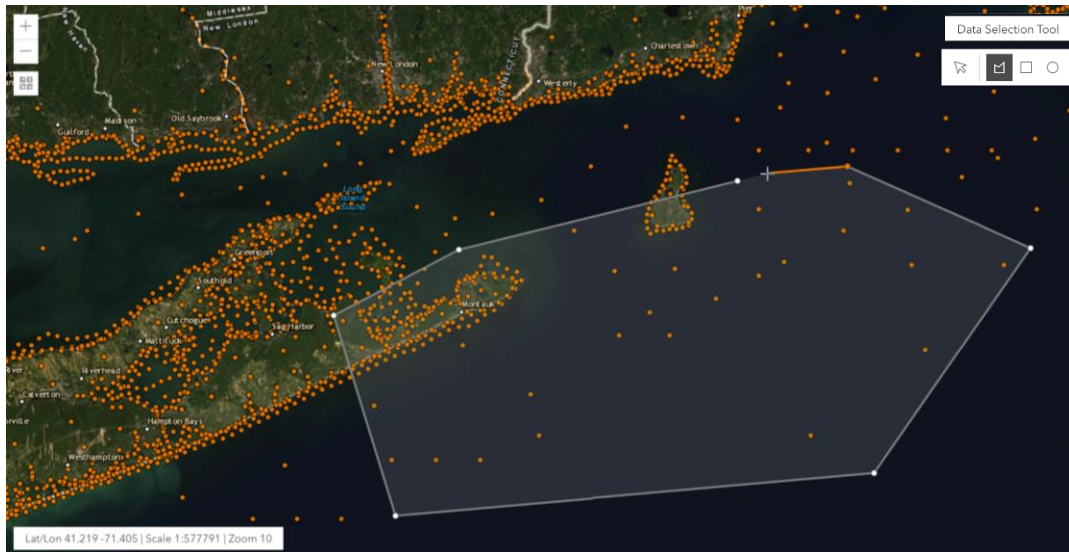
To select data, zoom in so that you can see the save points that you wish to select. On the top right, select one of the shapes: *polygon*, *rectangle*, or *circle* (Figure 18).

To use the *polygon tool*, select the polygon and then *left-click* once on the *Map* to set the first vertex of the polygon. Continue left clicking to place vertices of a polygon around the save points of interest. An orange line will show the bounds of the polygon, and the area enclosed will become shaded. Finish drawing the polygon by clicking on the original vertex placed on the map (Figure 18). The *Save Point Selection Window* will automatically appear over the *Map* containing the list of save points within the

polygon that was drawn.

You cannot step back to a previous vertex or change the polygon. To recreate a different polygon, click on the 'x' in the top right corner of the *Save Point Selection Window* and start your shape again.

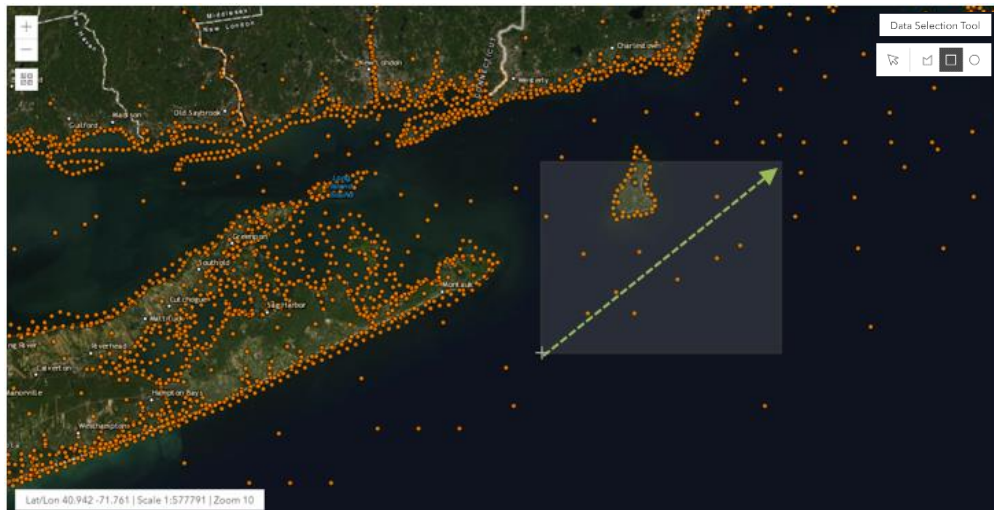
Figure 18: Selecting save point locations with polygon tool



To use the *rectangle tool*, select the rectangle and then *left-click and hold* the mouse button down to *drag* in your chosen direction from the start corner of the rectangle to the opposite end corner. The edges of the rectangle will form and a shaded area with a central cross-hair will be visible until you *release* the mouse button and finish the rectangle (Figure 19). The *Save Point Selection Window* will automatically appear over the *Map* containing the list of save points within the rectangle that was drawn.

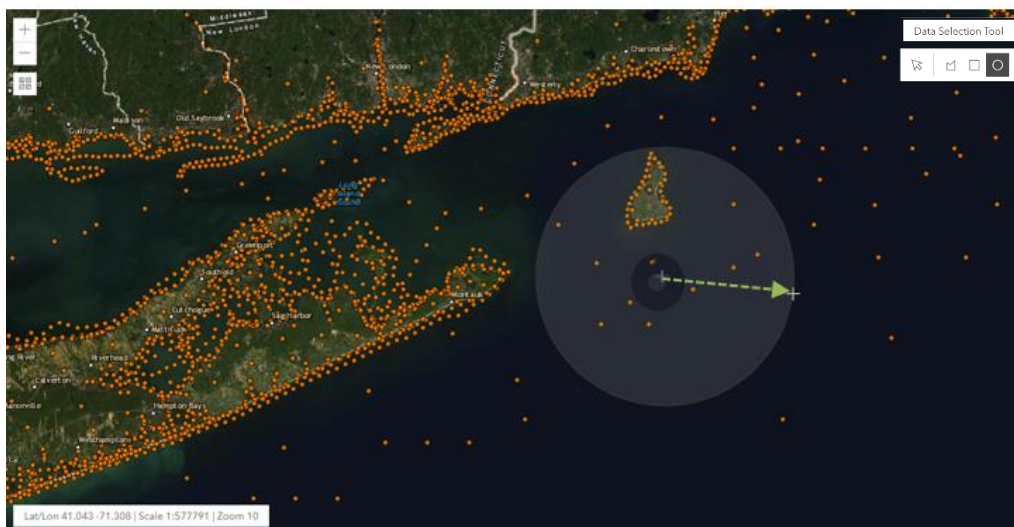
To use the circle tool, *left-click and hold* the mouse button down on the center of the circle and *drag* along any radius to the edge of the circle. The diameter of the circle will form and a shaded area will be visible until you *release* the mouse button and finish the circle (Figure 20). The *Save Point Selection Window* will automatically appear over the *Map* containing the list of save points within the circle that was drawn.

Figure 19: Selecting save point locations with rectangle tool



Note: green arrow is for visualization only and does not appear on screen in web tool

Figure 20: Selecting save point locations with circle tool



Note: green arrow is for visualization only and does not appear on screen in web tool

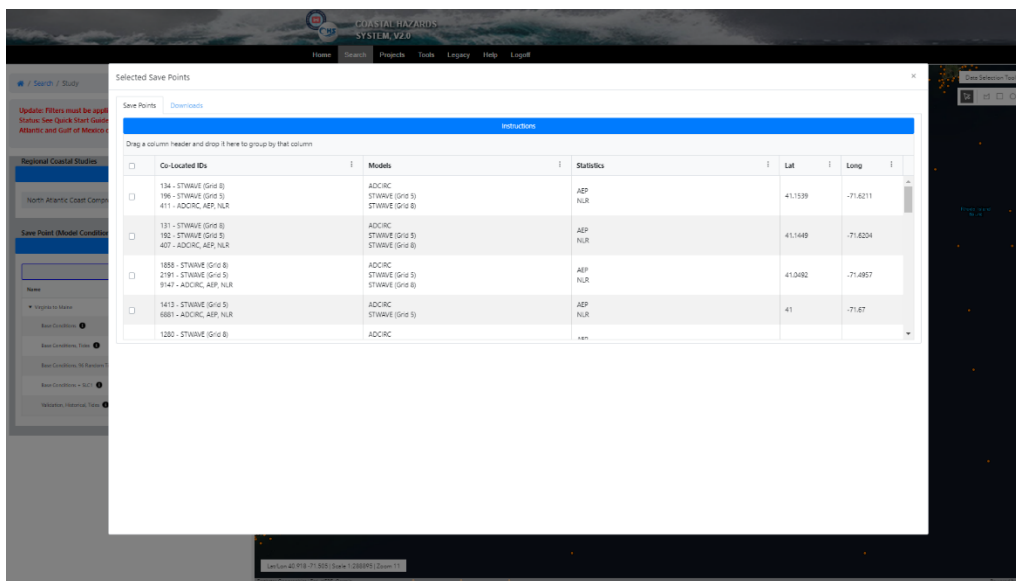
2 Downloading Model and Statistics Results

Once you have selected the save point locations of interest via the *Map Interface* using the tool described above, to reduce the set to save points of interest, you will be able to sort and filter the save points by ID, coordinates, and availability of model results and statistics results. From this set, a download tool will allow sorting and filtering by storm type, model result, statistics results, sub-region, model condition, and file attribute. Selected save point files can then be downloaded in an h5 or csv.

2.1 Save Point Filtering

After save points have been selected using the spatial shape tools from the *Map*, the *Save Point Selection and Download Window* will open with the spatially selected save points listed (Figure 21). The selected tab, shown in black text, is the *Save Points* tab. It is used for querying the Save Points selected on the *Map* in order to download associated files. This tab is automatically populated with the spatially queried save points identified on the *Map*. The top of the tab contains an instruction button with information on how to use this tool. After save points have been selected, you can continue to the *Downloads* tab. Though a download tool existed in the last version, the *Save Point Selection and Download Window* grid tool allows the user significant flexibility in viewing, sorting, filtering and querying data allowing CHS users to significantly reduce the amount of data they need to parse and download.

Figure 21: Save Points Selection tab showing instruction button and a row of save points

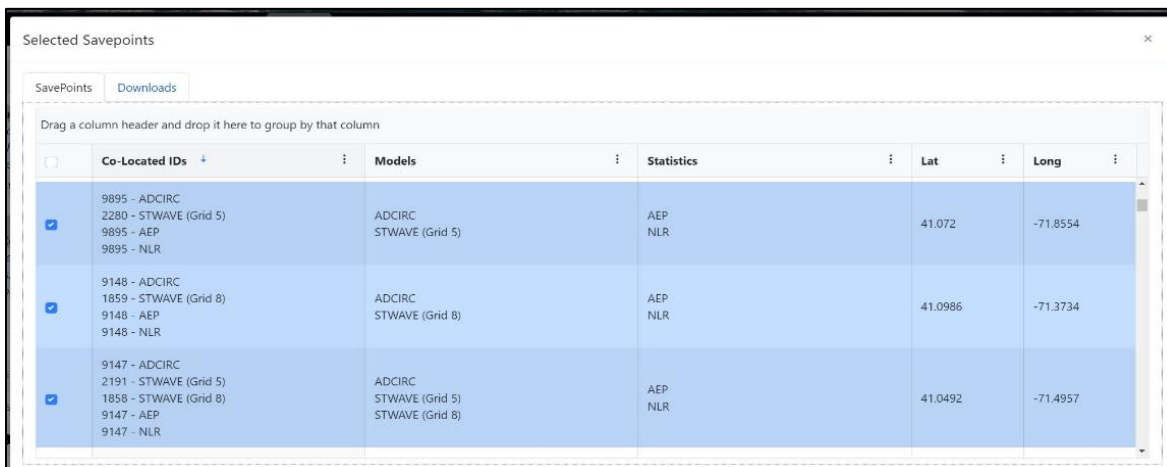


Instructions					
Drag a column header and drop it here to group by that column					
	Co-located IDs	Models	Statistics	Lat	Long
<input type="checkbox"/>	134 - STWAVE (SHG B)	ADCRC	AP	41.1539	-71.6211
<input type="checkbox"/>	186 - STWAVE (SHG B)	STWAVE (SHG B)	NUR		
<input type="checkbox"/>	411 - ADCRC, AP, NUR	STWAVE (SHG B)			
<input type="checkbox"/>	131 - STWAVE (SHG B)	ADCRC	AP	41.1449	-71.6204
<input type="checkbox"/>	182 - STWAVE (SHG B)	STWAVE (SHG B)	NUR		
<input type="checkbox"/>	487 - ADCRC, AP, NUR	STWAVE (SHG B)			
<input type="checkbox"/>	188 - STWAVE (SHG B)	ADCRC	AP	41.0482	-71.4957
<input type="checkbox"/>	259 - STWAVE (SHG B)	STWAVE (SHG B)	NUR		
<input type="checkbox"/>	9147 - ADCRC, AP, NUR	STWAVE (SHG B)			
<input type="checkbox"/>	1413 - STWAVE (SHG B)	ADCRC	AP	41	-71.67
<input type="checkbox"/>	6881 - ADCRC, AP, NUR	STWAVE (SHG B)	NUR		
<input type="checkbox"/>	1280 - STWAVE (SHG B)	ADCRC	AP		

The *Save Point Selection* tab contains rows with selectable checkboxes for each save point location with columns displaying the co-located IDs, Model Results and Statistics available, and coordinates of the point. Points can be selected for data download by either individually selecting the checkbox on the left end of the row, or by using the *select all* box at the top of the check-box column (Figure 22 and Figure

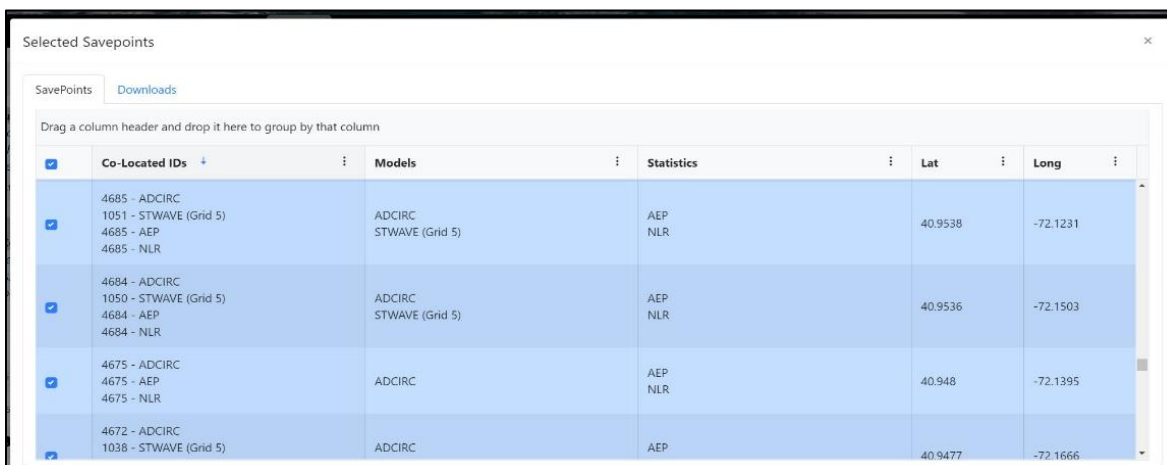
23). The *select all* checkbox selects all visible rows (not including those hidden by a filter), and can be used to de-select all boxes by de-selecting the *select all* checkbox.

Figure 22: Save Point Selection Window: Selecting individual save points



	Co-Located IDs	Models	Statistics	Lat	Long
<input checked="" type="checkbox"/>	9895 - ADCIRC 2280 - STWAVE (Grid 5) 9895 - AEP 9895 - NLR	ADCIRC STWAVE (Grid 5)	AEP NLR	41.072	-71.8554
<input checked="" type="checkbox"/>	9148 - ADCIRC 1859 - STWAVE (Grid 8) 9148 - AEP 9148 - NLR	ADCIRC STWAVE (Grid 8)	AEP NLR	41.0986	-71.3734
<input checked="" type="checkbox"/>	9147 - ADCIRC 2191 - STWAVE (Grid 5) 1858 - STWAVE (Grid 8) 9147 - AEP 9147 - NLR	ADCIRC STWAVE (Grid 5) STWAVE (Grid 8)	AEP NLR	41.0492	-71.4957

Figure 23: Selecting all save points



	Co-Located IDs	Models	Statistics	Lat	Long
<input checked="" type="checkbox"/>	4685 - ADCIRC 1051 - STWAVE (Grid 5) 4685 - AEP 4685 - NLR	ADCIRC STWAVE (Grid 5)	AEP NLR	40.9538	-72.1231
<input checked="" type="checkbox"/>	4684 - ADCIRC 1050 - STWAVE (Grid 5) 4684 - AEP 4684 - NLR	ADCIRC STWAVE (Grid 5)	AEP NLR	40.9536	-72.1503
<input checked="" type="checkbox"/>	4675 - ADCIRC 4675 - AEP 4675 - NLR	ADCIRC	AEP NLR	40.948	-72.1395
<input checked="" type="checkbox"/>	4672 - ADCIRC 1038 - STWAVE (Grid 5)	ADCIRC	AEP	40.9477	-72.1666

To change column width, hover on the line between columns and drag the column width icon that appears (←||→, Figure 24). To sort a column (ascending or descending) click the column header (Figure 25). A blue arrow will show the direction sorted. Click the blue arrow to reverse direction. To group the list by column, click and drag the column header and drop it in the grouping bar titled "Drag a column header and drop it here to group by that column" located just above the grid (Figure 26). To remove any grouping, click the "X" next to the column name in the grouping bar.

Figure 24: Adjusting Column Width

	Co-Located IDs	Models	Statistics	Lat	Long
<input type="checkbox"/>	5007 - ADCIRC 1335 - STWAVE (Grid 5) 5007 - AEP 5007 - NLR	ADCIRC STWAVE (Grid 5)	AEP NLR	41.093	-72.0587
<input type="checkbox"/>	9913 - ADCIRC 2298 - STWAVE (Grid 5) 9913 - AEP 9913 - NLR	ADCIRC STWAVE (Grid 5)	AEP NLR	41.0179	-72.2519
<input type="checkbox"/>	9949 - ADCIRC 2334 - STWAVE (Grid 5) 9949 - AEP 9949 - NLR	ADCIRC STWAVE (Grid 5)	AEP NLR	41.08	-72.2772

Figure 25: Sorting Latitude Column with blue down arrow

	Co-Located IDs	Models	Statistics	Lat	Long
<input type="checkbox"/>	9991 - ADCIRC 2194 - STWAVE (Grid 8) 9991 - AEP 9991 - NLR	ADCIRC STWAVE (Grid 8)	AEP NLR	41.4318	-70.9296
<input type="checkbox"/>	9416 - ADCIRC 2092 - STWAVE (Grid 8) 9416 - AEP 9416 - NLR	ADCIRC STWAVE (Grid 8)	AEP NLR	41.2975	-70.653
<input type="checkbox"/>	739 - ADCIRC 262 - STWAVE (Grid 8) 739 - AEP 739 - NLR	ADCIRC STWAVE (Grid 8)	AEP NLR	41.113	-70.7624
<input type="checkbox"/>	885 - ADCIRC				

For more detailed filtering, sorting, and available columns, click the **:** icon at the end of each column header (Figure 27). A menu will appear that allows for sorting direction(s), column(s) to display, and filtering the associated column. Select the checkboxes under the *Columns* menu to show and hide desired columns (Figure 28). Filtering is available under the *Filter* menu based on column type. Filter options are either checkboxes for pre-defined filtering of unique values (such as *Model Types* in Use, see *Downloads* tab example in Figure 32) or a custom value for text filtering (such as part of an ID).

Figure 26: Group by Column Example

Top: Dragging column header to Drag a... area; Middle: Grouped by Models; Bottom: Grouped with Models: ADCIRC collapsed

The figure consists of three vertically stacked screenshots of the 'Selected Savepoints' window. Each window has a 'SavePoints' tab and a 'Downloads' link. Below the tabs is a header area with a prompt 'Drag a column header and drop it here to group by that column' and a '+ Models' button.

Top Screenshot (Ungrouped): The table has columns: Co-Located IDs, Models, Statistics, Lat, and Long. The data is as follows:

Co-Located IDs	Models	Statistics	Lat	Long
3910 - STWAVE (Grid 5) 14476 - AEP 14476 - NLR	ADCIRC STWAVE (Grid 5)	AEP NLR	40.9835	-72.0703
4862 - ADCIRC 1211 - STWAVE (Grid 5) 1662 - AEP	ADCIRC STWAVE (Grid 5)	AEP NLR	41.0228	-72.0941

Middle Screenshot (Grouped by Models): The 'Models' column is collapsed, and a 'Models: ADCIRC' group is visible. The data is as follows:

Co-Located IDs	Models	Statistics	Lat	Long
4675 - ADCIRC 4675 - AEP 4675 - NLR	ADCIRC	AEP NLR	40.948	-72.1395
4842 - ADCIRC 4842 - AEP 4842 - NLR	ADCIRC	AEP NLR	41.0124	-71.9415
4853 - ADCIRC 4853 - AEP 4853 - NLR	ADCIRC	AEP NLR	41.0194	-72.1084

Bottom Screenshot (Grouped with Models: ADCIRC collapsed): The 'Models' column is collapsed, and a 'Models: ADCIRC STWAVE (Grid 5)' group is visible. The data is as follows:

Co-Located IDs	Models	Statistics	Lat	Long
3722 - ADCIRC 614 - STWAVE (Grid 5) 3722 - AEP 3722 - NLR	ADCIRC STWAVE (Grid 5)	AEP NLR	41.0741	-71.9342
9901 - ADCIRC 2286 - STWAVE (Grid 5) 9901 - AEP 9901 - NLR	ADCIRC STWAVE (Grid 5)	AEP NLR	41.0229	-72.0427

Figure 27: Save Point Selection Window showing filter tools

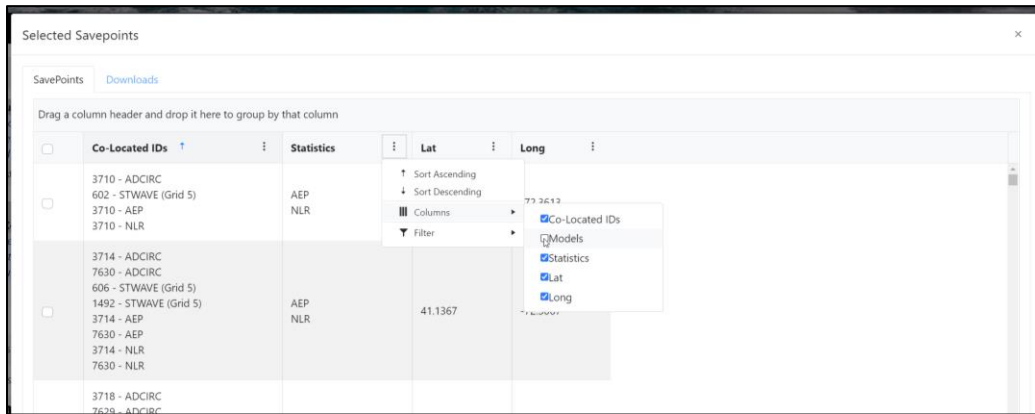
The screenshot shows the 'Selected Savepoints' window with the 'Models' column selected. A context menu is open over the 'Models' column header, showing the following options:

- Sort Ascending
- Sort Descending
- Columns
- Filter

The table data is as follows:

Co-Located IDs	Models	Statistics	Lat	Long
9991 - ADCIRC 2194 - STWAVE (Grid 8) 9991 - AEP 9991 - NLR	ADCIRC STWAVE (Grid 8)	AEP NLR	41.4318	-70.9296
9416 - ADCIRC 2092 - STWAVE (Grid 8) 9416 - AEP 9416 - NLR	ADCIRC STWAVE (Grid 8)	AEP NLR	41.113	-70.653
739 - ADCIRC 262 - STWAVE (Grid 8) 739 - AEP 739 - NLR	ADCIRC STWAVE (Grid 8)	AEP NLR	41.2975	-70.7624
885 - ADCIRC	ADCIRC	AEP		

Figure 28: Removing a Column



For value filtering, options are *Contains*, *Starts with*, or *Is equal to*. Choose your desired method and enter the value or text in the *search box* and select *Filter* (do not use * or ~ notation). For example, in Figure 29, the *Co-Located IDs* column is filtered for terms containing 'Grid 5'. Then, with the filter still on, the *Select All* checkbox is checked, selecting only those points that contain 'Grid 5' (Figure 30, Top). Once the filter is turned off, the *Select All* check box is unchecked, but the filtered items remain checked (Figure 30, middle, bottom) and rows (or points) that do not contain Grid 5 (i.e. only contain Grid 8 or no STWAVE Grids in this set) are not selected.

To cancel a filter for any column, return to : and to the *Filter* menu and click on the *Clear* button to remove the associated columns filter. See [Telerik's Grid API](#) for a similar sorting and filtering examples.

To continue to the *Downloads* tab, you must select at least one (1) or more rows. Choose the *Downloads* tab at the top to continue.

Figure 29: Filter by text using Contains

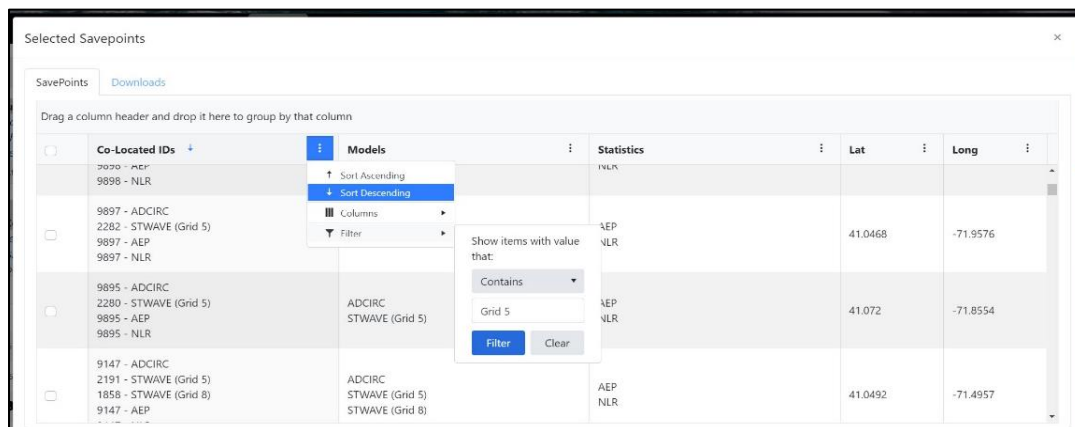


Figure 30: Selecting all save points in a filtered group

Top: Selecting all save points that contain 'Grid 5' in their Models type, showing unselected save point row containing 'Grid 8', not 'Grid 5';
Bottom: Showing save point row showing no STWAVE (Grid #)

The figure consists of three screenshots of the 'Selected Savepoints' interface. The top screenshot shows the 'SavePoints' tab with a filter applied to the 'Models' column. The filter is set to 'Contains' and the value is 'Grid 5'. The table shows several rows, with the first row (9898 - NLR) unselected and the second row (9897 - ADCIRC) selected. The middle screenshot shows the same filter applied, but the dropdown menu is closed. The bottom screenshot shows the 'Downloads' tab selected, displaying a list of files. The files are listed with their names, model types, and statistics.

Co-Located IDs	Models	Statistics	Lat	Long
9898 - AEP		NLR		
9898 - NLR				
9897 - ADCIRC				
2282 - STWAVE (Grid 5)				
9897 - AEP				
9897 - NLR				
9895 - ADCIRC				
2280 - STWAVE (Grid 5)				
9895 - AEP				
9895 - NLR				
9147 - ADCIRC				
2191 - STWAVE (Grid 5)				
1858 - STWAVE (Grid 8)				
9147 - AEP				

Co-Located IDs	Models	Statistics	Lat	Long
9898 - AEP		NLR		
9898 - NLR				
9897 - ADCIRC				
2282 - STWAVE (Grid 5)				
9897 - AEP				
9897 - NLR				
9895 - ADCIRC				
2280 - STWAVE (Grid 5)				
9895 - AEP				
9895 - NLR				
9148 - ADCIRC				
1859 - STWAVE (Grid 8)				
9148 - AEP				
9148 - NLR				

Co-Located IDs	Models	Statistics	Lat	Long
4685 - ADCIRC				
1051 - STWAVE (Grid 5)				
4685 - AEP				
4685 - NLR				
4684 - ADCIRC				
1050 - STWAVE (Grid 5)				
4684 - AEP				
4684 - NLR				
4675 - ADCIRC				
4675 - AEP				
4675 - NLR				
4672 - ADCIRC				
1038 - STWAVE (Grid 5)				

2.2 Selecting and Downloading Files

After clicking the *Downloads* tab, the list of files associated with the selected save point is displayed on the tab with the title, *Downloads*, now shown in black text (Figure 31). The files can be sorted and filtered by Storm Type, Model Result or Statistics Result type, sub-Region or Model Condition, and file attributes (e.g. Peaks or Timeseries). The filename is shown as a reference for the user and also to indicate the directory structure if the file is downloaded.

All the table/grid manipulation, sorting, filtering, and selection discussed above in the *Save Point Selection* tab applies in this tab as well. Since many of the columns contain unique values, examples here demonstrate using the pre-defined filtering of unique values option. For example, in Figure 32, the list of files is filtered by two unique values of *Storm Type*: *TS* for Tropical Synthetic Storms, and *VAL* for Validation Storms. In Figure 33, two unique values are selected from two different columns: *Condition* set to *Base Conditions* and *Attribute* set to *Timeseries*. This allows the user great flexibility to only download data for the model condition and type of data needed for their scope.

Figure 31: Download Files Window

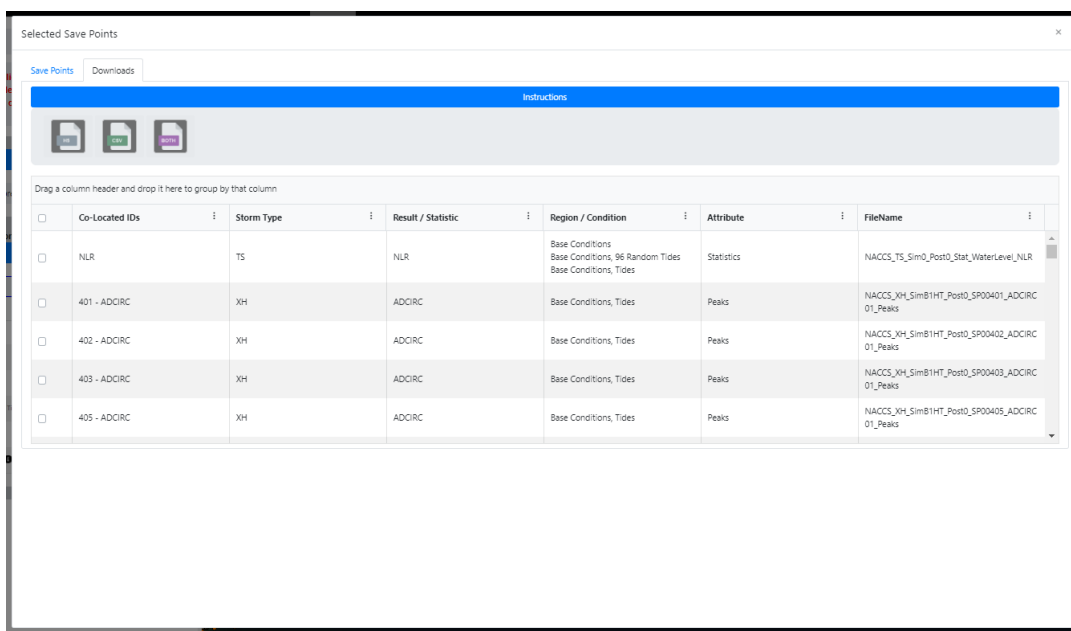


Figure 32: File selection by two unique values

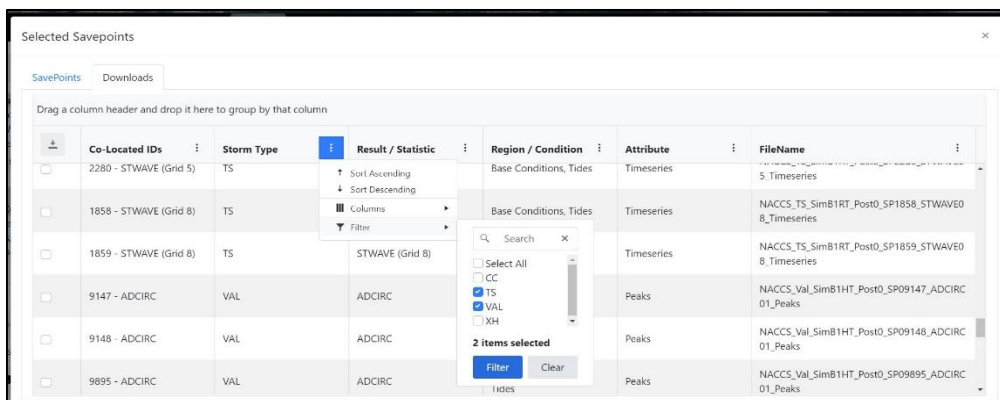


Figure 33: File selection by two columns - Condition set to Base Conditions and Attribute set to Timeseries

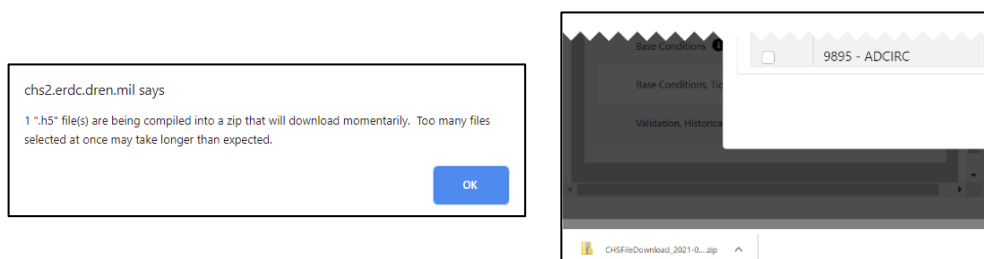
	Co-Located IDs	Storm Type	Result / Statistic	Region / Condition	Attribute	FileName
<input type="checkbox"/>	2280 - STWAVE (Grid 5)	XH	STWAVE (Grid 5)	Base Conditions	Timeseries	NACCS_XH_SimB_Post0_SP2280_STWAVE05_Timeseries
<input type="checkbox"/>	1858 - STWAVE (Grid 8)	XH	STWAVE (Grid 8)	Base Conditions	Timeseries	NACCS_XH_SimB_Post0_SP1858_STWAVE08_Timeseries
<input type="checkbox"/>	1859 - STWAVE (Grid 8)	XH	STWAVE (Grid 8)	Base Conditions	Timeseries	NACCS_XH_SimB_Post0_SP1859_STWAVE08_Timeseries
<input type="checkbox"/>	9147 - ADCIRC	TS	ADCIRC	Base Conditions	Timeseries	NACCS_TS_SimB_Post0_SP09147_ADCIRC01_Timeseries
<input type="checkbox"/>	9148 - ADCIRC	TS	ADCIRC	Base Conditions	Timeseries	NACCS_TS_SimB_Post0_SP09148_ADCIRC01_Timeseries
<input type="checkbox"/>	9895 - ADCIRC	TS	ADCIRC	Base Conditions	Timeseries	NACCS_TS_SimB_Post0_SP09895_ADCIRC01_Timeseries

After filtering and sorting, select the files from this tab that you wish to download by clicking the checkbox next to them. Then select Download H5 or .CSV files. Note that downloads will take longer for more files, files that are large (such as timeseries files) and for download as .CSV which involves a conversion.

Your download will begin immediately in the form of a single zip file named CHSFileDownload_YYYY-MM-DD_HH-MM-SS.zip. An alert will appear that the server has received your request. The file will be placed in your default Downloads location folder (Figure 34). If the notice does not appear and a blank webpage is opened, this indicates that either the conversion or download failed. Although uncommon, please contact the website administrators if this occurs.

Note that the folder paths are maintained in the downloaded zip, separating model results, storm types and data types.

Figure 34: Download Alert and Zip File



3 Viewing Statistics Data

The Statistics data viewing capability is currently under development and will be available soon.

Statistics results for individual point locations will be included in the CHS Web Tool. The ongoing development will allow users to view AEF/AEP results from the on-click pop-up box by point in a table format for easy viewing. Further development is expected to include viewing results on the *Map* and through queries, similar to the NLR visualization in the CHS v1.1 tool. Lastly, a data viewing tab is expected to be added to the Save Point Selection and Download Tab Windows.

3.1 Storm Track Data

The Storm Tracks capabilities are currently under development and will be available soon. Visual queries under development will include storm tracks of synthetic and historical tropical cyclones.

3.2 CHS Web Tool File Formats

The CHS Web Tool currently stores and distributes specific spatial location data files (save point/station location) in HDF5, also known as H5, format. Data files for Model results downloaded via the map interface of the CHS Web Tool are in the H5 format.

The CHS Web Tool has been updated to allow downloading of data files in .CSV format. Additionally, users may access the Tools tab in CHS for local conversion of downloaded H5 files. From this tab, users may access:

- MATLAB script that will convert any H5 format file to CSV format.
 - MATLAB script that will convert any H5 format file to a MATLAB structure for data manipulation
- Non-MatLab users can download a free software package called HDFView that will allow the user to view the data and export individual datasets to ASCII files. Please visit the following website for instructions and additional information. (www.hdfgroup.org) For specific data requests, please refer to the Contact Us page and contact one of our team members.

4 Appendix A: Coastal Hazards System File Formats

Last update: 11/16/2021

4.1 Model Results

4.1.1 HDF5 Model

The CHS HDF5 data model for specific model results (ADCIRC, STWAVE, SWAN or WAM) can be constructed using Table 1 and Table 2. Each HDF5 file represents model results output at a save point (latitude, longitude, depth, ID) which contains a collection of objects (*e.g.*, groups, dataset, attributes...). For all model results data, each file includes a root group, which is the actual file and *n* groups under the root group where *n* represents the number of storms modeled. The model results HDF5 file group format and their attributes conform to Table 1.

The HDF5 file format varies for the different models at the dataset level as each model has a different set of responses (*e.g.*, water elevation, significant wave height, mean wave direction, etc.). Table 2 provides a listing of the identified outputs for each model. Under each storm group in the HDF5 file, there are *m* datasets where *m* represents the number of output types per model.

Note that some attributes may not exist in the HDF5 file for certain projects. Two result types are available at a given save point: timeseries and peaks. In the NACCS files, the data models for time series and peaks files are the same except for an additional dataset found in the peaks files named Annual Exceedance Probability (AEP) (highlighted in grey in Table 2). Please note that this AEP dataset within the peaks files has no values and will be removed from the files in future updates. The AEP values are now located in a separate file (ref. Section 4.3.1, Table 9 below).

Table 1: Timeseries – Groups and Potential Attributes

HDF5	Name/Format	Potential Attributes
Root Group (File)	Name: Filename Format: refer to CHS filename convention doc	Latitude Units Longitude Units Save Point ID Save Point Latitude Save Point Longitude Project Region Sub-Region Vertical Datum CHS Data Format Grid Name (<i>STWAVE</i>) Model Run Condition Model Run Condition Description CHS File Format

Groups	<p>Name: Storms Format: StormName-Num</p> <ul style="list-style-type: none"> - StormName is the string representing CHS storm name convention - Num represents a number and is only used for database indexing; may be same as StormID value <p>Name: Tropical Synthetic Storms Format: Synthetic_StormID-Num</p> <ul style="list-style-type: none"> - StormName is the string "Synthetic" followed by a StormID identifying the number of each synthetic storm modeled <p>Name: Tropical Historical Storms Format: StormName_StormID- Num</p> <ul style="list-style-type: none"> - StormName is the actual storm name followed by the HURDAT storm ID if applicable <p>Name: ExtraTropical Historical Storms Format: StormPeakdate- Num</p> <ul style="list-style-type: none"> - StormName is the date in yyyyymmddHHMM format of the peak surge event for the storm 	<p>Save Point Depth Save Point Depth Units Storm ID Storm Name Storm Type Record Interval Record Interval Units Steric Level Steric Adjustment Steric Adjustment Description Steric Adjustment Units Grid Configuration Packet</p>
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Table 2: Timeseries – Potential Datasets and Attributes

Model	Datasets	Attributes
ADCIRC	<p>Atmospheric Pressure Depth Averaged Density (<i>Optional</i>) Scalar Concentration (<i>Optional</i>) Water Elevation X Depth Averaged Velocity Y Depth Averaged Velocity X Wind Velocity Y Wind Velocity yyyyymmddHHMM Annual Exceedance Probability</p>	<p>Units Model Variable</p>
STWAVE	<p>Mean Wave Direction Mean Wave Period Zero Moment Wave Height Peak Period Radiation Stress Gradients (<i>Optional</i>)</p>	<p>Units Model Variable</p>

	Water Elevation Wave Breaking Indices <i>(Optional)</i> Wind Direction Wind Magnitude yyyymmddHHMM Annual Exceedance Probability	
WAM	Significant Wave Height Total Sea Spectral Wave Period Total Sea Peak Spectral Wave Period Total Sea Mean Wave Period Total Sea First Moment Wave Period Total Sea Second Moment Wave Period Total Sea Mean Wave Direction Total Sea Wave Directional Spread Total Sea Wind Speed Wind Direction Friction Velocity Drag Coefficient Normalized Wave Stress Significant Wave Height Wind Sea Spectral Wave Period Wind Sea Peak Spectral Wave Period Wind Sea Mean Wave Period Wind Sea First Moment Wave Period Wind Sea Second Moment Wave Period Wind Sea Mean Wave Direction Wind Sea Wave Directional Spread Wind Sea Significant Wave Height Swell Spectral Wave Period Swell Peak Spectral Wave Period Swell Mean Wave Period Swell First Moment Wave Period Swell Second Moment Wave Period Swell Mean Wave Direction Swell Wave Directional Spread Swell yyyymmddHHMM Annual Exceedance Probability	Units Model Variable
SWAN	Bottom Level <i>(Optional)</i> Bottom Wave Period <i>(Optional)</i> Curve Distance From First Point To Output Point Location <i>(Optional)</i> Difference In RTM01 Average Wave Period <i>(Optional)</i> Difference In Significant Wave Height <i>(Optional)</i> Directional Spreading <i>(Optional)</i>	Units Model Variable

Energy Dissipation <i>(Optional)</i> Energy Transport <i>(Optional)</i> Energy Transport Direction <i>(Optional)</i> Fraction Of Breaking Wave Due To Depth Induced Breaking <i>(Optional)</i> Frequency Spreading <i>(Optional)</i> Friction Coefficient <i>(Optional)</i> Mean Absolute Wave Period PER <i>(Optional)</i> Mean Absolute Wave Period TM01 Mean Absolute Wave Period TMM10 <i>(Optional)</i> Mean Absolute Zero Crossing Period <i>(Optional)</i> Mean Relative Wave Period RPER <i>(Optional)</i> Mean Relative Wave Period RTM01 <i>(Optional)</i> Mean Relative Wave Period RTMM10 <i>(Optional)</i> Mean Wave Direction Mean Wavelength <i>(Optional)</i> Numerical Energy Loss <i>(Optional)</i> Peak Wave Direction <i>(Optional)</i> Radiation Stresses <i>(Optional)</i> Relative Peak Period <i>(Optional)</i> Rms Maxima Orbital Velocity At Bottom <i>(Optional)</i> Rms Orbital Velocity At Bottom <i>(Optional)</i> Significant Wave Height Smoothed Peak Period Swell Significant Wave Height <i>(Optional)</i> Water Depth <i>(Optional)</i> Water Level <i>(Optional)</i> Mean Wave Period Wave Setup <i>(Optional)</i> Wave Steepness <i>(Optional)</i> X Current Velocity <i>(Optional)</i> X Wind Velocity <i>(Optional)</i> Y Current Velocity <i>(Optional)</i> Y Wind Velocity <i>(Optional)</i> yyyyMMddHHMM Annual Exceedance Probability	
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Important Note: NACCS Peaks data files downloaded prior to May 2016 are in a slightly different H5 format. Those peaks files included an additional dataset: Maxele 1-96 (highlighted in grey in Table 3). This dataset represents the peaks of the combined surge (Base Conditions) and tide responses corresponding to each of the 96 random tide phases simulated in ADCIRC.

Table 3: Peaks – NACCS Original H5 Format Groups, Datasets and Attributes

HDF5	Name/Format	Attributes
Root Group (File)	Name: Filename Format: refer to CHS filename convention doc	Latitude Units Longitude Units Save Point ID Save Point Latitude Save Point Longitude Project Region Sub-Region Vertical Datum CHS Data Format
Groups	Name: Storms Format: StormName-Num <ul style="list-style-type: none"> - StormName is the string representing CHS storm name convention - Num represents a number and is only used for database indexing; may be same as StormID value Name: Tropical Synthetic Storms Format: Synthetic_StormID-Num <ul style="list-style-type: none"> - StormName is the string "Synthetic" followed by a StormID identifying the number of each synthetic storm modeled Name: Tropical Historical Storms Format: StormName_StormID- Num <ul style="list-style-type: none"> - StormName is the actual storm name followed by the HURDAT storm ID if applicable Name: ExtraTropical Historical Storms Format: StormPeakdate- Num <ul style="list-style-type: none"> - StormName is the date in yyyyymmddHHMM format of the peak surge event for the storm 	Save Point Depth Save Point Depth Units Storm ID Storm Name Storm Type Record Interval Record Interval Units Steric Level
Datasets	Atmospheric Pressure Water Elevation X Depth Averaged Velocity Y Depth Averaged Velocity X Wind Velocity Y Wind Velocity	Units Model Variable

	yyyymmddHHMM Annual Exceedance Probability Maxele 1-96	
--	--	--

Peaks - CHS File Format V2: The file format of the Peaks data changed with the South Atlantic Coastal Study (SACS). In this updated format, the Groups were eliminated, and the peaks values are now represented only as Datasets. Organizing the files as one Dataset per response (e.g., water elevation, significant wave height, mean wave direction, etc.) is a much more efficient approach than using Groups. Each Dataset is now a single column of peaks values with the column length (number of rows) being the number of storms. A Dataset for the Storm Name (historical storms) or Storm ID (synthetic storms) was added to reference the rows in the other Datasets to the associated storm. Using the HDFView program, a visual comparison of CHS File Formats V1 and V2 is provided in Figure 35 and Figure 36.

An important change was also made for referencing the time. A Dataset named Peak Time was added and represents hours before (+) or after (-) the storm made landfall. For instance, a value of 3.5 means that the Peak Water Elevation at this savepoint location and for this particular storm occurred 3 and a half hours prior to the storm making landfall. If the value were -3.5, the Peak Water Elevation would have occurred 3 and a half hours after the storm made landfall. Another Dataset added to this format is Landfall Time, which is the number of hours since a defined origin time of 1970-01-01 00:00:00Z. Since landfalls are not recorded for extratropical cyclones, the Peak Time and Landfall Time Datasets are recorded as NaN for this storm type. Additionally, the Peak Time Dataset for historical tropical cyclones contains -99999 values in cases where the peak water level was recorded by ADCIRC during the tidal spin-up period of the storm simulation.

Figure 35: Example NACCS Peaks File Using the CHS Peak File Format V1

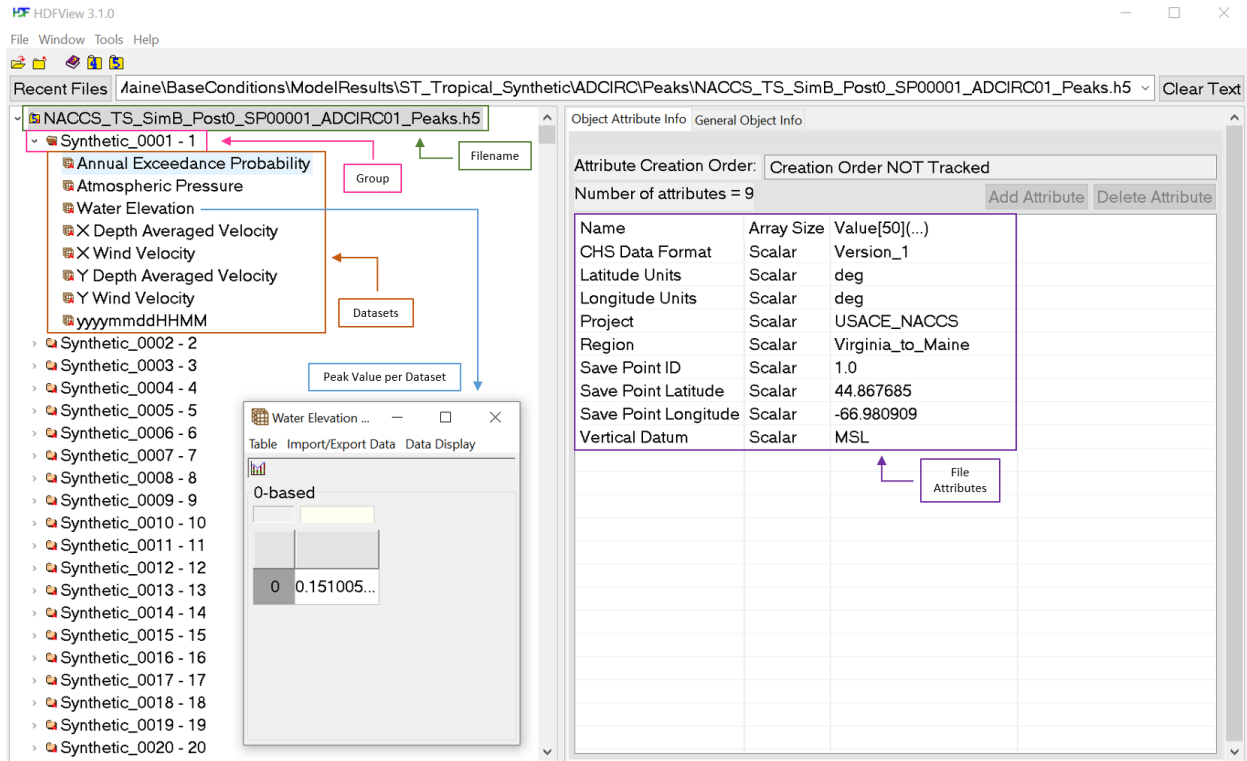
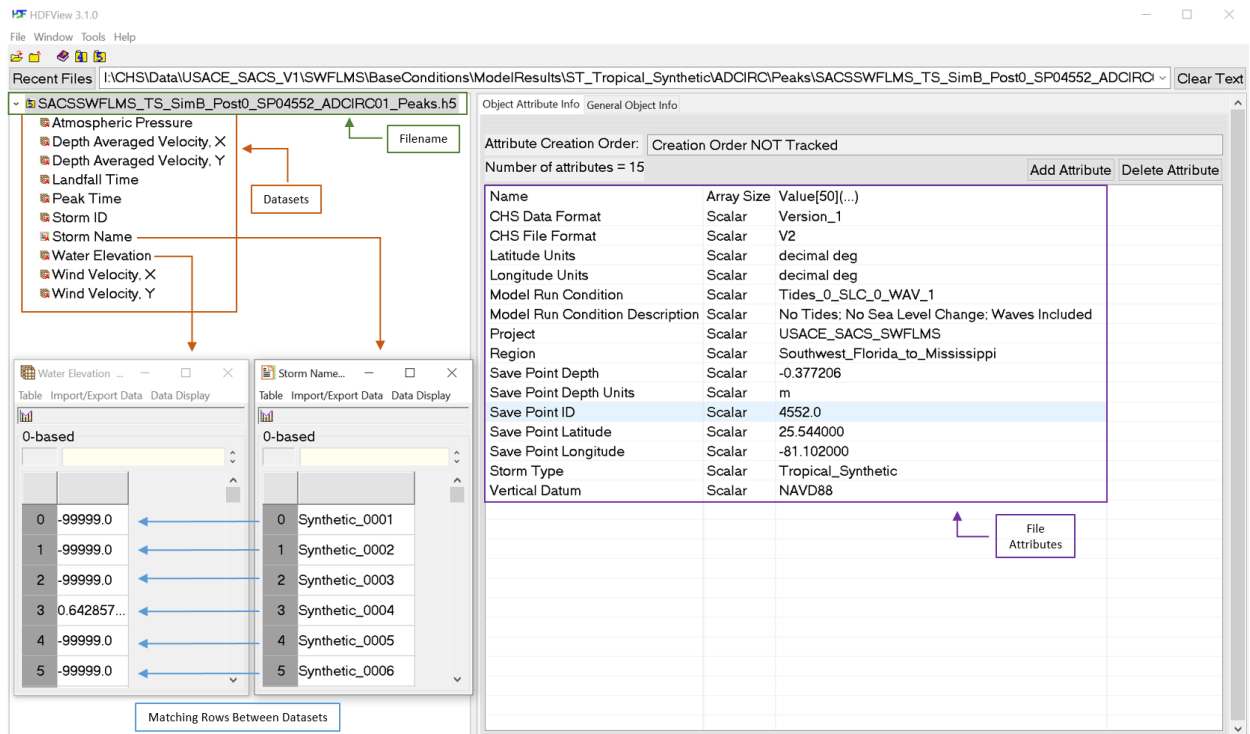


Figure 36: Example SACS Peaks File Using the CHS Peak File Format V2



Important Note for CHS Peaks File Format V2: Due to changes in the methods for exporting peaks values from the hydrodynamic models, the SACS: NCSEFL and SWFLMS peaks values were defined in a different manner from other CHS study regions. The peak values in the STWAVE datasets were output at the time of the peak Significant Wave Height (H_{m0}), and the STWAVE peaks values are only available at the ADCIRC save point locations. The structure of the file format for the STWAVE V2 peaks files is provided in Table 5.

However, only the maximum water elevation tables were exported for the ADCIRC peaks values. Therefore, the peaks values for the additional datasets in the ADCIRC peaks files for SACS: NCSEFL and SWFLMS are not correlated in time with the maximum water elevation and represent only the peak value that occurred for that dataset during the timeseries of the storm. Table 4 provides the format of the HDF5 model for the ADCIRC V2 peaks files.

Table 4: ADCIRC Peaks – CHS File Format V2

HDF5	Name/Format	Attributes
Root Group (File)	Name: Filename Format: Refer to CHS filename convention doc	CHS Data Format CHS File Format Latitude Units Longitude Units Model Run Condition Model Run Condition Description Project Region Save Point Depth Save Point Depth Units Save Point ID Save Point Latitude Save Point Longitude Vertical Datum
Datasets	Atmospheric Pressure Depth Averaged Velocity, X Depth Averaged Velocity, Y Landfall Time Peak Time Storm ID Water Elevation Wind Velocity, X Wind Velocity, Y	Description Model Variable Units

Table 5: STWAVE Peaks – CHS File Format V2

HDF5	Name/Format	Attributes
Root Group (File)	Name: Filename Format: refer to CHS filename convention doc	CHS Data Format CHS File Format Grid Name Latitude Units Longitude Units Model Run Condition Model Run Condition Description Project Region Save Point Depth Save Point Depth Units Save Point ID Save Point Latitude Save Point Longitude Vertical Datum
Datasets	Landfall Time Mean Wave Direction Mean Wave Period Peak Time Peak Wave Period Significant Wave Height Storm ID Water Elevation Wind Direction Wind Magnitude	Description Model Variable Units

4.1.2 CSV Format

The model results, AEF, and conditional AEF data can be converted to csv files on the fly using the csv conversion button available when downloading files within CHS. Downloadable MATLAB and Python scripts are also available in the Tools page for converting locally saved HDF5 files of modeling results. All model results csv files have three header rows:

- Header row 1 = Column name
- Header row 2 = Model variable (if applicable else blank)
- Header row 3 = Units (if applicable else blank)

The columns in CHS timeseries and peaks csv files are defined in Table 6 and Table 7, respectively. Table these tables provide a listing of the identified outputs per model. Please note that the total number of columns in a model results csv file for either timeseries or peaks results is project specific

as the file only includes the recorded model outputs for that particular project.

Table 6: CSV Format - Timeseries

Column Number	Column Name	Model Variable	Units
1	Save Point ID		
2	Save Point Latitude		deg
3	Save Point Longitude		deg
4	Save Point Depth		m
5	Storm Name		
6	Storm Type		
7	Storm ID		
8	yyyymmddHHMM or yyyymmddHHMMSS		
...	Remaining columns consist of model outputs		

Table 7: CSV Format - Peaks

Column Number	Column Name	Model Variable	Units
1	Save Point ID		
2	Save Point Latitude		deg
3	Save Point Longitude		deg
4	Save Point Depth		m
5	Storm Name		
6	Storm Type		
7	Storm ID		
8	Time		
9	Peak Time		
10	Landfall Time		
...	Remaining columns consist of model outputs		

4.2 Storm Parameters

4.2.1 CSV Format

The storms parameters file contains the hurricane parameters for a particular project. Storm parameters files are accessible via the Library within the CHS website. All storm parameters csv files have two header rows:

- Header row 1 = Column name
- Header row 2 = Parameter symbol
- Header row 3 = Units (if applicable, else blank)

As shown in Table 8, the first 3 columns of all CHS storm parameters csv files are identical with the remaining columns providing the parameters for each storm.

Table 8: Storm Parameters csv File Header Rows

Column Number	Column Name	Variable	Units
1	Storm Name		
2	Storm Type		
3	Storm ID		
4	Central Pressure Deficit	Cp	hPa
5	Heading Direction	Hd	deg
6	Radius of Maximum Wind	Rmax	km
7	Reference Latitude	deg	deg
8	Reference Longitude	deg	deg
9	Translational Speed	Vt	km/h

4.3 Statistics HDF5 Data Model

4.3.1 Annual Exceedance Probability (AEP) Data Files/ per save point

The annual exceedance probability (AEP) files contain joint probability analysis results for identified save point locations for a particular simulation set (base conditions, base conditions+ tides) and a particular response parameter (water level, wave height, wave period, etc.). Currently, the projects representing the statistical analysis results as AEPs are NACCS and S2G. Each AEP file includes the following datasets:

- Response expected value (mean) corresponding to thirteen AEPs: 1E+00, 5E-01, 2E-01, 1E-01, 5E-02, 2E-02, 1E-02, 5E-03, 2E-03, 1E-03, 5E-04, 2E-04, 1E-04
- Confidence Limit (CL) dataset for each AEP. The number of CL datasets provided is project specific. The nominal values of the CLs are specified in the dataset name (example: Confidence Limit 84% AEP)

Table 9: Annual Exceedance Probability (AEP) HDF5 format

HDF5	Name/Format	Attributes
Root Group (File)	Name: refer to CHS filename convention doc	Project Region CHS Data Format Vertical Datum Save Point ID Save Point Latitude Save Point Longitude Latitude Units Longitude Units
Groups	Name: refer to CHS filename convention doc Identifier1_ Identifier2 _ Identifier3_ Identifier4_ Identifier5 _ Identifier6_ Identifier7 Identifier1= Project Region Sub region Identifier2= Storm Type Identifier3= Simulation Identifier4= Post-processing Identifier5= Save Point Identifier6= Model Parameter Identifier7= Result Type	Identifier2 description Identifier3 description Identifier4 description Identifier7 description
Datasets	Expected Value AEP	AEP values* Units
	Format : Confidence Limit x for AEP Confidence Limits x% for each AEP where x is the nominal value of the CL	AEP values* Units

*AEP values: 1E+00, 5E-01, 2E-01, 1E-01, 5E-02, 2E-02, 1E-02, 5E-03, 2E-03, 1E-03, 5E-04, 2E-04, 1E-04

Table 10: Annual Exceedance Probability (AEP) CSV format

Column Number	Column Name	Description
1	Save Point ID	save point ID
2	Save Point Latitude	save point latitude in decimal degrees
3	Save Point Longitude	save point longitude in decimal degrees
4	AEP values	
5	Parameters	
6	Expected Value AEP	Mean AEP
7 – end	[Confidence Limit <i>x</i> for AEP] where <i>x</i> is the nominal value of the CL	

4.3.2 Annual Exceedance Frequency (AEF) Data Files/ per save point

The annual exceedance frequency (AEF) files contain joint probability analysis results for identified save point locations for a particular simulation set (base conditions, base conditions + tides, base conditions + sea level change) and a particular response parameter (*e.g.*, still water level, wave height, wave period). Currently, the only project representing the statistical analysis results as AEFs is SACS. Each AEF file includes the following datasets:

- Response best estimate value (mean) corresponding to 22 AEF values*
- Confidence Limit (CL) dataset for each AEF which indicates the probability that a response corresponding to a given AEF will not be exceeded during an event. The number of CL datasets provided is project specific. The nominal values of the CLs are specified in the dataset name (example: Confidence Limit 90% AEF)

Table 11: Annual Exceedance Frequency (AEF) HDF5 format

HDF5	Name/Format	Attributes
Root Group (File)	Name: refer to CHS filename convention doc	CHS Data Format CHS File Format Latitude Units Longitude Units Model Run Condition Model Run Condition Description Project Region Save Point Depth Save Point Depth Units Save Point ID Save Point Latitude Save Point Longitude

		Vertical Datum
Groups	Name: refer to CHS filename convention doc Identifier1_ Identifier2 _ Identifier3_ Identifier4_ Identifier5 _ Identifier6_ Identifier7 Identifier1= Project Region Sub region Identifier2= Storm Type Identifier3= Simulation Identifier4= Post-processing Identifier5= Save Point Identifier6= Model Parameter Identifier7= Result Type	Identifier2 description Identifier3 description Identifier4 description Identifier7 description
Datasets	AEF Values*	AEF Values Description Units
	Best Estimate AEF	AEF Values Description Units
	Format : Confidence Limit x for AEF Confidence Limits x% for each AEF where x is the nominal value of the CL	AEF Values Description Units

*AEF values: 10E+00, 5E+00, 2E+00, 1E+00, 5E-01, 2E-01, 1E-01, 5E-02, 2E-02, 1E-02, 5E-03, 2E-03, 1E-03, 5E-04, 2E-04, 1E-04, 5E-05, 2E-05, 1E-05, 5E-06, 2E-06, 1E-06

Table 12: Annual Exceedance Frequency (AEF) CSV format

Column Number	Column Name	Description
1	Save Point ID	save point ID
2	Save Point Latitude	save point latitude in decimal degrees
3	Save Point Longitude	save point longitude in decimal degrees
4	Vertical Datum	
5	Parameter	
6	Units	
7	AEF Values	units
8	Best Estimate AEF	mean AEF
9 – end	[Confidence Limit x for AEF] where x is the nominal value of the CL	

4.3.3 Storm Recurrence Rate (SRR) Data Files

The storm recurrence rate (SRR) files define the frequency of occurrence for tropical historical storms relative to a geographical location. The frequency of occurrence defined by units of storms/year/km is based on the historical record of storms within a given area of influence. The original SRR files developed for NACCS also contain storm relative probabilities (SRPs) based on the joint probability of storm parameters for a set of save points. However, this file format was updated for SACS, and the storm probabilities were split into a separate file as documented in Section 4.3.4. See the respective technical reports for details regarding the computation of these statistics.

In the NACCS SRR file, this statistics file includes the following datasets as documented in Table 13:

- Save Point Locations for save point ID, longitude and latitude
- Low Intensity Storm Rate
- High Intensity Storm Rate
- n storm relative probabilities datasets where n is the number of storms. These datasets are identified as the *Storm Name* followed by “SRP” (example: Synthetic_0001 SRP)

Table 13: NACCS Storm Recurrence Rate (SRR) HDF5 format

HDF5	Name/Format	Attributes
Root Group (File)	Name: refer to CHS filename convention doc	Project Region CHS Data Format
Groups	Storm Rate	
	Storm Relative Probabilities	
Datasets	Save Point ID	
	Save Point Latitude	Latitude Units
	Save Point Longitude	Longitude Units
	Low Intensity Storm Rate	Units
	High Intensity Storm Rate	Units
	Format : <i>Storm Name</i> followed by “SRP”	

Table 14: NACCS Storm Recurrence Rate (SRR) CSV format

Column Number	Column Name	Description
1	Save Point ID	save point ID
2	Save Point Latitude	save point latitude in decimal degrees
3	Save Point Longitude	save point longitude in decimal degrees
4	Low Intensity Storm Rate	Low intensity storm recurrence rate in number of storms per year per kilometer
5	High Intensity Storm Rate	High intensity storm recurrence rate in number of storms per year per kilometer
6-1055	[Storm Name SRP]	Storm relative probabilities for modeled storms for all save points

In the SACS SRR file, this statistics file includes the following datasets as documented in the tables below:

- Save Point Locations for save point ID, longitude and latitude
- Low Intensity Storm Rate
- Medium Intensity Storm Rate
- High Intensity Storm Rate
- All Intensity Storm Rate

Table 15: Storm Recurrence Rate (SRR) HDF5 format – CHS File Format V2

HDF5	Name/Format	Attributes
Root Group (File)	Name: refer to CHS filename convention doc	Project Region CHS Data Format CHS File Format
Groups	Storm Rate	
Datasets	Save Point Locations	Columns
	Low Intensity Storm Rate	Units
	Medium Intensity Storm Rate	Units
	High Intensity Storm Rate	Units
	All Intensity Storm Rate	Units

Table 16: Storm Recurrence Rate (SRR) CSV format – CHS File Format V2

Column Number	Column Name	Description
1	Save Point ID	save point ID
2	Save Point Latitude	save point latitude in decimal degrees
3	Save Point Longitude	save point longitude in decimal degrees
4	Low Intensity Storm Rate	Low intensity storm recurrence rate in number of storms per year per kilometer
5	Medium Intensity Storm Rate	Medium intensity storm recurrence rate in number of storms per year per kilometer
5	High Intensity Storm Rate	High intensity storm recurrence rate in number of storms per year per kilometer
7	All Intensity Storm Rate	All intensity storm recurrence rate in number of storms per year per kilometer

4.3.4 Probability Mass Data Files

The probability mass values define the probability of occurrence for the synthetic storms and are described by units of storms/year. The probability mass values are specific to each synthetic storm. The file includes the following datasets:

- Probability Mass value
- Storm ID
- Storm Name

Table 17: Probability Mass HDF5 Format

HDF5	Name/Format	Attributes
Root Group (File)	Name: refer to CHS filename convention doc	Project Region CHS Data Format
Datasets	Probability Mass	Description Units
	Storm ID	Description
	Storm Name	Description

Table 18: Probability Mass CSV Format

Column Number	Column Name	Units
1	Storm ID	
2	Storm Name	
3	Probability Mass	storms/year

4.3.5 Nonlinear Residual (NLR) Data Files

The nonlinear residual data files (NLR) contains the bias and uncertainty for identified save point locations to account for the errors that result from using linear superposition of tide and surge or surge and sea level change to determine still water level (SWL). Uncertainty here is the square root of the sum of the squares of standard deviations from component uncertainties. The file includes the following datasets:

- Save Point Locations for save point ID, longitude and latitude
- Astronomical Tide Bias from linear superposition of astronomical tide and surge
- Astronomical Tide Uncertainty from linear superposition of astronomical tide and surge
- Global Sea Level Change Bias from linear superposition of surge and global sea level change
- Global Sea Level Change Uncertainty from linear superposition of surge and global sea level change

Table 19: Nonlinear Residual (NLR) HDF5 Format

HDF5	Name/Format	Attributes
Root Group (File)	Name: refer to CHS filename convention doc	Project Region CHS Data Format
Datasets	Save Point ID	
	Save Point Latitude	Latitude Units
	Save Point Longitude	Longitude Units
	Astronomical Tide Bias	Units
	Astronomical Tide Uncertainty	Units
	Global Sea Level Change Bias	Units
	Global Sea Level Change Uncertainty	Units

	Global Sea Level Change + Tide Bias	Units
	Global Sea Level Change + Tide Uncertainty	Units

Table 20: Nonlinear Residual (NLR) CSV Format

Column Number	Column Name	Description
1	Save Point ID	save point ID
2	Save Point Latitude	save point latitude in decimal degrees
3	Save Point Longitude	save point longitude in decimal degrees
4	Astronomical Tide Bias	Bias from superposition of surge and tide in meters
5	Astronomical Tide Uncertainty	Uncertainty from superposition of surge and tide in meters
6	Global Sea Level Change Bias	Bias from superposition of surge and sea level rise in meters
7	Global Sea Level Change Uncertainty	Uncertainty from superposition of surge and sea level rise of in meters
8	Global Sea Level Change + Tide Bias	Bias from superposition of surge, sea level rise and tide in meters
9	Global Sea Level Change + Tide Uncertainty	Uncertainty from superposition of surge, sea level rise and tide in meters

5 Appendix B: Coastal Hazards System Filename Convention

Last update: 11/16/2021

The Coastal Hazards System (CHS) filename convention has a standard set of unique identifiers which make up the filenames for the data files posted in the system. These identifiers allow each filename to be self-describing. Detailed information for each identifier is provided below. In the following, ID stands for identification number.

5.1 Filename Format

The filename convention for model results per save point, observations, parameters, and statistics files follows the convention:

Identifier1_ Identifier2 _ Identifier3_ Identifier4_ Identifier5 _ Identifier6_ Identifier7.Extension

5.2 Identifier Descriptions

5.2.1 Identifier1 = Project || Region || Sub region

Identifier1 consists of a string specifying project name, region name or sub region name, depending on the data structure.

Example: NACCS_TS_SimB_Post0_SP0002_STWAVE03_Peaks.h5

5.2.2 Identifier2 = Storm Type || Data Type

Identifier2 consists of a string specifying either the storm type or the data type.

Example: NACCS_TS_SimB_Post0_SP0002_STWAVE03_Peaks.h5

Table 21 lists the current storm type and data type identifiers, along with a description of each.

Table 21: Identifier1 Details

Format	Description
TS	Model results for Tropical Synthetic storm type
XH	Model results for Extratropical Historical storm type
TH	Model results for Tropical Historical storm type
XS	Model results for Extratropical Synthetic storm type
CC	Statistics for Combined (Tropical Extratropical/Historical Synthetic) storm type

Val	Model results for Validations
Obs	All available measurements for a particular station
Obs6min*	6 min interval observations
ObsHourly*	Hourly interval observations
ObsMonthly*	Monthly observations

*Observations: specific to csv files

5.2.3 Identifier3 = Simulation

Identifier3 consists of a string that defines the simulation parameters for a specific project.

Example: NACCS_TS_SimB_Post0_SP0002_STWAVE03_Peaks.h5

Table 22 lists the current simulation identifiers along with a description of each.

Table 22: Identifier3 Details

Format	Description
Sim0	No simulation (statistics files, parameters files, or observation data files)
SimB	Base Conditions; No tides; No sea level change (slc)
SimB1RT	Base plus 1 random tide; No slc (model results for NACCS)
SimB1HT	Base plus 1 historical tide; No slc (model results for NACCS, SACS)
SimB1RTgslc1p0	Base plus 1 random tide plus global sea level change 1.0 m (model results for NACCS)
SimBslc1	Base plus sea level change app. 1 m; No tides (model results for SACS)
SimBslc2	Base plus sea level change app. 2 m; No tides (model results for SACS)
SimBHL	Base Historical Levels (model results for Great Lakes)
SimBAL	Base Average Lake Levels (model results for Great Lakes)
SimBCL	Base Current Lake Levels (model results for Great Lakes)
SimBP	Base with project conditions (model results for Sabine to Galveston (S2G))

5.2.4 Identifier4 = Post-processing

Identifier4 consists of a string specifying the types of post-processing performed. Note that these may be project-specific.

Example: NACCS_TS_SimB_Post0_SP0002_STWAVE03_Peaks.h5

Table 23 lists the current post-processing identifiers along with a description of each.

Table 23: Identifier4 Details

Format	Description
Post	Indicates file contains results with more than one post-processing type (statistics for SACS)
Post0	No Post Processing (statistics for NACCS, SACS)

Post1RT	1 random tide (statistics for NACCS, SACS)
Post96RT	96 random tides (model results for NACCS)
Post96RTgslc0p5	96 random tides plus global sea level change 0.5 m (statistics for NACCS)
Post96RTgslc1p0	96 random tides plus global sea level change 1.0 m (statistics for NACCS)
Post96RTgslc1p5	96 random tides plus global sea level change 1.5 m (statistics for NACCS)
Post96RTgslc2p0	96 random tides plus global sea level change 2.0 m (statistics for NACCS)
PostPmod	Parsing of modeled storms using observations data
PostPpot	Parsing storms using Peaks Over Threshold method for observations data

5.2.5 Identifier5 = Save Point || Station || Statistics || Storm

Identifier5 consists of a string specifying either the save point ID, the storm ID, the observation station ID, or the data type.

Example: NACCS_TS_SimB_Post0_SP0002_STWAVE03_Peaks.h5

Table 24 lists the current identifier5 format and description.

Table 24: Identifier5 Details

Format	Description
SP	All save points for the specific project
SP#	SP followed by a save point ID (model results for any project)
Sta#	Sta followed by a station ID (observations data) If Source=NOAA then # = 7 character station ID If Source=NDBC then # = 4 or 5 character station ID
ST	All storms for the specified project (applies to storm data)

5.2.6 Identifier6 = Model

Identifier6 consists of a string specifying the model name, and grid number where applicable, for model results. This identifier is also used to specify the statistics parameter for statistics files, the type of model input or output file, the source for storm tracks and characteristics, or the source of observations data.

Example: NACCS_TS_SimB_Post0_SP0002_STWAVE03_Peaks.h5

Table 25 lists the current identifier6 format and description.

Table 25: Identifier6 Details

Format	Description
ADCIRC#	ADCIRC model followed by the grid ID (grid ID 01 is default)
STWAVE#	STWAVE model followed by the grid ID
WAM#	WAM model followed by the grid ID (grid ID 01 is default)
SWAN#	SWAN model followed by the grid ID (grid ID 01 is default)
Storms	Model parameter specific to statistics files

Fort	ADCIRC input or output file
TROP	Track and storm characteristics description file
HURDAT	Track and storm characteristics description file from the HURricane DATabase
NOAA	National Oceanic and Atmospheric Administration (source for observations data)
NDBC	National Data Buoy Center (source for observations data)
WL	Water Level (Model parameter specific to statistics files)
SWL	Still Water Level (Parameter specific to statistics files; accounts for surge + tides)
Hs	Wave Height (Model parameter specific to statistics files)
Hm0	Significant Wave Height (Model parameter specific to statistics files)
Tp	Wave Period (Model parameter specific to statistics files)
Stat	File contains statistics data

5.2.7 Identifier7 = Result Type || Input Type

Identifier7 consists of a string specifying the type of data contained within the file.

Example: NACCS_TS_SimB_Post0_SP0002_STWAVE03_Peaks.h5

Table 26 lists the current identifier7 format and description.

Table 26: Identifier7 Details

Format	Description
TimeSeries	Model results and observations
Peaks	Model results and observations
TimeHistory	Observations only
AEP	Annual Exceedance Probability (statistics files)
AEF	Annual Exceedance Frequency (statistics files)
AEFcond	Annual Exceedance Frequency (statistics files, conditional)
SRR	Storm Recurrence Rate (statistics files)
STcond	Storm Conditions
Param	Storm Parameters (synthetic storms)
NLR	Nonlinear Residual
NLRgslcU	Global Sea Level Change Uncertainty
NLRgslcUr	Global Sea Level Change Relative Uncertainty
NLRgslcB	Global Sea Level Change Bias
NLRgslcBr	Global Sea Level Change Relative Bias
NLRtideU	Astronomical Tide Uncertainty
NLRtideUr	Astronomical Tide Relative Uncertainty
NLRtideB	Astronomical Tide Bias

NLRtideBr	Astronomical Tide Relative Bias
NLRtidegslcU	Global Sea Level Change + Tide Uncertainty
NLRtidegslcUr	Global Sea Level Change + Tide Relative Uncertainty
NLRtidegslcB	Global Sea Level Change + Tide Bias
NLRtidegslcBr	Global Sea Level Change + Tide Relative Bias
MinMax	File contains min and max data (maxele, maxrs, maxwvel, minpr, swan_HS, swan_TP, swan_DIR, swan_TPS ..)
ProbMass	Probability Mass (synthetic storms, statistics files)

5.2.8 Extension

Table 27 lists the possible extensions.

Table 27: Extension Details

Format	Description
.h5	HDF5 data model, library and file format for storing and managing data
.csv	Comma Separated Values
.kml	Keyhole Markup Language